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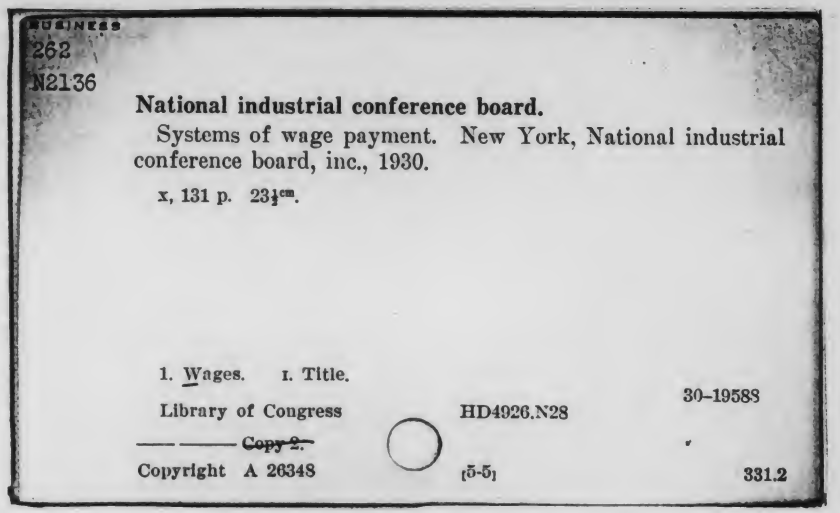

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SYSTEMS OF WAGE PAYMENT

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PREFACE

LIMITATION of the output per worker, however caused, is uneconomic. It is a loss of potential earnings both to the employer and to the worker, and of potential service to the public. Such limitation prevents the fullest and, therefore, most economic utilization of the equipment of production. It stands in the way of reducing unit costs of production, the goal of modern management. If by so doing it dams up for the time being a source of managerial profit, it also obstructs the lowering of prices, which ultimately becomes a boon to the consumer. It is a hardship to the worker whose ability rises above the average, since it holds him down to a lower rate of compensation than his abilities warrant.

If certain systems of wage payment tend inherently to such a limitation of output, it is obviously in the general interest that they should be superseded by systems which offer the promise of more abundant results to the employer and to the worker. To examine the several systems of wage payments in use in modern industry, with reference to their possible tendencies in respect to the volume of output and its unit cost and in respect to the remuneration of the workers, is the purpose of the present volume. It is not intended to be a study of wages generally but of wage differentials as they are developed under different systems of wage payment.

It is well recognized that systems of wage payment are often part and parcel of the entire system of industrial management, and that in practice it is extremely difficult to separate the results to be attributed to methods of wage payment from those which flow from the managerial system as a whole. It will thus be evident that any statements which may be made with regard to one system or another must be interpreted in the light of conditions which surround its application.

The National Industrial Conference Board has sought in the present volume to present the essential features of wage

payment systems without in any case recommending or passing judgment upon them. Complex mathematical formulæ and engineering charts have been avoided. If, notwithstanding, the exposition of systems may at times seem rather theoretical, it is tempered by the rich experience of manufacturers who have adopted special systems or experimented with them. Throughout the work, the theoretical treatment of the different systems is supplemented by quotations from the correspondents of the Board, which bring to light in the most concrete and convincing manner the actual workings of the plans discussed. It is this combination of theory and experience which leads to hope that in this volume the National Industrial Conference Board has made a substantial contribution to knowledge of one of the ever-present and fundamental problems of industrial management.

In the preparation of its studies the National Industrial Conference Board avails itself of the experience and judgment of the business executives who compose its membership and of recognized authorities in special fields in addition to the scientific knowledge and equipment of its Research Staff. The publications of the Board thus finally represent the result of scientific investigation and broad business experience, and the conclusions expressed therein are those of the Conference Board as a body.

This volume is the result of investigations which have been made from time to time by members of the Conference Board's Research Staff under the supervision of the Board's Staff Economic Council.

MAGNUS W. ALEXANDER
President

New York
May, 1930

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INTRODUCTION

THE question of the system of wage payment to be employed in an industrial establishment goes deeper than the mere mechanism of the payroll. It vitally affects the earnings of workers, costs, the volume and quality of production, and so, ultimately, prices and the general economic situation.

The problems involved in the discussion of systems of wage payment, however, are distinct from those of the general wage level and even from those which enter into the fixation of a just wage. They are in small degree, if at all, concerned with the forces which determine the customary or usual wages for a given occupation. For the greater part they involve the question of deviations from that usual wage in the earnings of efficient workers, and of the effect of such differential wages upon the position of workers and employers and, through them, upon the economic well-being of the community. The study of the systems of wage payment is thus essentially a study in the technology of efficiently or economically rewarding labor for its contribution to production. The problem is one of avoiding or reducing "wasted wages," which is probably one of the most important sources of waste in industry.

The simplest method of wage payment, and that which in the early days of the factory system prevailed most widely, is that based on time. Yet there have been many who contend that the usual time wage does not bring out the full efficiency of the workers when skill is a factor, and even that it has a tendency to reduce the product of every worker to the level of the least efficient. So far as this is the case it results in wasted opportunities, and waste here as elsewhere is prejudicial to the interests of all.

The problem then concerns, in the first instance, the earnings of workers of different degrees of efficiency. If the best worker and the poorest worker are paid at the same rate, there is a tendency towards uniformity of output, and in practice the difference between the better and the poorer

workers tends to be obliterated. If, however, it is possible to devise a plan whereby each worker is paid in some degree proportionally to his output, not only does the wage cost of the product more nearly accord with its value, but a motive or "incentive" is furnished to the men of higher capacity to put forth their best efforts. Experience shows that workers respond to such incentives. Latent capabilities are awakened, work becomes more intensive and more productive because it is more profitable to the worker.

Furthermore, the system of wage payment has a direct bearing upon manufacturers' costs, to the extent that one system may bring out a higher degree of productiveness than another. The costs of manufacture, whether they be wages of labor or other expense, are spread over the entire product. The greater the product for a given outlay, the smaller the unit cost. If, with a given manufacturing organization and equipment, the product of labor can be increased without a wage increase, unit costs will obviously be lowered. Again, a wage increase swelling the outlay for labor does not of necessity involve a corresponding increase in other manufacturing expense, particularly that designated generally as overhead expense. Therefore, if an increase in the product of labor can be effected by paying higher wages to labor, it may be profitable to do so if a proper proportion can be found between increased wage payments and increased product. The wage adjustments contemplated by incentive wage systems will, it is claimed, generally bring about such an enhancement of the labor product. They may in theory, therefore, despite larger gross payments for wages, bring about a reduction of labor cost, and in practice such a result is frequently obtained.

It would seem superfluous to insist upon the benefit to the community at large of high earnings for wage earners and low costs for manufacturers. For any immediate group concerned it means that both employer and workers have a larger income for the satisfaction of their needs and usually that a larger volume of the product is purchasable with a unit of income. Multiply these results throughout the community, extend them to as many industries and occupations as possible, and the increased well-being of all follows.

These are the economic implications of the problem of systems of wage payments. It is only necessary to mention them to show the significance of the question for our industrial life. But the relative effectiveness of different methods of wage payment and their adaptation to the needs of individual establishments indifferent fields of production present many complex and controversial questions.

In the present report, the National Industrial Conference Board has sought to ascertain the prevalence in American industry of the various systems of wage payment, to evaluate the time wage system and the principal systems which have been devised to supplant or supplement it, and to ascertain the experience of manufacturers who use the various systems.

The first step of the investigation was to ascertain as nearly as possible the extent to which different systems of wage payment were in use. In order to give the study as broad and unbiased a scope as possible, a list of nearly three thousand companies of appreciable size was made up at random from a commercial register. To each of these companies was sent a simple questionnaire asking information regarding the type of industry, the total number employed, the length of the work-week, and the percentage of workers under each of various wage systems.

Replies received from 1,214 plants showed the employment in them of 777,376 workers, or a little more than 9% of all wage earners in manufacturing industries reported by the 1927 Census of Manufactures. These establishments varied considerably in size. Since the extent to which incentive wage plans are in force is largely conditioned by the magnitude of the enterprise, it is important to indicate the distribution of plants in terms of the scale of operations, measured here by the number of workers in the plant.

Table 1 shows the range of variation in the size of establishments reporting as well as the number of workers in their employ. For present purposes it is convenient to refer to plants employing less than 150 workers as small, to those having between 151–1,500 workers as medium-sized and to those with over 1,500 workers as large. Two-fifths of the 1,214 establishments fall into the first class, about one-half in the second and less than 8% in the third group. On the

basis of this classification it appears that the smaller firms predominate among the reporting companies. On the other hand, the greater proportion of the 777,376 employees were in the larger plants. The small plants employed only about 5% of the total number of workers, those of medium-size some what more than one-third of the total number, and the large firms over 55% of all workers.

TABLE 1: PLANTS AND WORKERS COVERED BY STUDY
(Source: National Industrial Conference Board)

Number of Workers	Plants		Wage Earners	
	Number	Per Cent	Number	Per Cent
1–50	155	12.8	4,529	0.6
51–100	191	15.7	14,845	1.9
101–150	142	11.7	17,799	2.3
151–350	324	26.7	76,277	9.8
351–750	187	15.4	96,932	12.5
751–1,500	122	10.0	128,068	16.5
1,501–3,500	57	4.7	128,337	16.5
3,501 and over	36	3.0	310,589	39.9
Total	1,214	100.0	777,376	100.0

To what extent is this distribution typical of all manufacturing establishments? The latest year for which the United States Census of Manufactures classified workers by size of establishment was 1923. The Conference Board conducted its first inquiry into the extent of the use of the different wage systems in that same year. The distribution of plants in the 1928 investigation was very close to the results derived in 1923. Smaller firms were somewhat fewer and medium-sized plants somewhat more numerous in the earlier inquiry.

TABLE 2: DISTRIBUTION OF PLANTS BY NUMBER OF WORKERS, IN 1923 AND 1928
(Source: National Industrial Conference Board)

Number of Workers	1923		1928	
	Number of Plants	Per Cent	Number of Plants	Per Cent
1–150	312	31.0	488	40.2
151–350	262	26.1	324	26.7
351–750	218	21.7	187	15.4
751–1,500	123	12.2	122	10.0
1,501–3,500	60	6.0	57	4.7
3,501 and over	30	3.0	36	3.0
Total	1,005	100.0	1,214	100.0

This general similarity in distribution in the two years makes it reasonable to compare the 1928 figures of the Conference Board with those of the Census of Manufactures of 1923. In 1923, according to the Census of Manufactures, 91.5% of all establishments employed less than 100 workers; in the Conference Board's 1928 study only 28.5% of all the plants fell within the group having less than 100 workers on the payrolls. Furthermore, according to the Census of Manufactures, 28.7% of all factory workers in the United States were in plants employing less than 100 workers, whereas in the Conference Board sample only 2.5% of all workers fell into this class. The conclusion is evident; replies in this survey were received from the larger firms in the country. This resulted from the fact that the firms were selected from lists supplied by trade associations, to which belong the larger firms of an industry. It was believed that specialized incentive systems were more likely to be found among these larger establishments than among the thousands of very small concerns included in the Census of Manufactures.

How did these firms compare with respect to the different wage systems used? To what extent did the small, medium-sized and large concerns show similar or different tendencies in the methods of paying their employees? Tables 3 and 4 throw light upon these questions.

One of the most interesting results to be drawn from an examination of Table 3 is that 367 or 30% of all the plants reported that they used the time-wage basis of payment only.

TABLE 3: DISTRIBUTION OF PLANTS BY SYSTEMS OF WAGE PAYMENT, 1928
(Source: National Industrial Conference Board)

System of Wage Payment	Plants		Wage Earners	
	Number	Per Cent	Number	Per Cent
Time wage only	367	30.2	64,861	8.3
Straight piece rates	599	49.4	413,748	53.3
Piece rates and other incentive systems	146	12.0	211,015	27.1
Special incentive systems without piece rates	102	8.4	87,752	11.3
Total	1,214	100.0	777,376	100.0

On the other hand, the piece wage was used in 745 plants, or 60% of the total number. Plants using special incentive systems without piece rates were 102 in number, or 8.4% of the total.

The same table shows that of a total of 777,376 workers, 8.3% were employed in plants having a time wage exclusively. Plants which had introduced piece rates in some form but had no other incentive systems in operation employed 53.3% of all the workers in the group, while 27.1% were employed in plants with composite wage plans whereby both piece rates and other incentive systems were in use. Finally, 11.3% of the workers were employed in plants which had no piece rates but had some other form of incentive system. Summing up then, 80.4% of the workers were employed in plants where some form of piece rates was used, and 11.3% in plants which used some other form of incentive system.

That there is a close association between systems of wage payment and size of plant is clearly shown by Table 4. Among plants of from one to one hundred and fifty workers, somewhat more than 50% have the time wage only. This proportion diminishes as plants increase in size. The reverse is true when these establishments are compared with respect to the use of piece wages. As the plants increase in size, the proportion using piece rates in some form, or to some extent,

TABLE 4: DISTRIBUTION OF PLANTS BY NUMBER OF WORKERS AND SYSTEM OF WAGE PAYMENT, 1928
(Source: National Industrial Conference Board)

Number of Workers	Plants				
	Total	Using Time Wage Only	Using Piece Rates and Other Incentives		
			Piece Rates	Piece Rates in Combination with Other Incentives	Other Incentive Systems without Piece Rates
1–50	155	106	40	4	5
51–100	191	95	85	5	6
101–150	142	51	68	10	13
151–350	324	75	182	35	32
351–750	187	31	102	35	19
751–1,500	122	6	69	29	18
1,501–3,500	57	2	38	12	5
3,501 and over	36	1	15	16	4
Total	1,214	367	599	146	102

grows. Piece rates are represented in 43% of the plants with less than 150 employees, and in 87% of the plants with more than 1,501 workers.

The use of incentive systems, with or without piece rates, tells a similar story. In all, 248 plants or 20% of the total covered by the inquiry use special incentive systems to a greater or less extent. In the group of plants having one to one hundred and fifty workers, there are 8.8% in which these other incentive systems are represented. This proportion rises gradually to 30% in the group with 751 to 1,500 workers. Fifty-five per cent of plants employing 3,501 workers and over reported other incentive systems.

TABLE 5: DISTRIBUTION OF EMPLOYEES IN PLANTS BY SIZE OF ESTABLISHMENT AND SYSTEMS OF WAGE PAYMENT, 1928
(Source: National Industrial Conference Board)

Number of Employees	Number of Employees in Plant				
	Total	Using Time Wages	Using Piece Rates and Other Incentives		
			Piece Rates	Piece Rates in Combination with Other Incentives	Other Incentive Systems without Piece Rates
1–150	37,173	16,627	16,463	1,792	2,291
151–350	76,277	17,061	43,094	8,373	7,749
351–750	96,932	16,444	51,938	18,074	10,476
751–1,500	128,068	5,305	73,660	30,477	18,626
151–1,500	301,277	38,810	168,692	56,924	36,851
1,501–3,500	128,337	4,595	87,173	25,511	11,058
3,501 and over	310,589	4,829	141,420	126,788	37,552
1,501 and over	438,926	9,424	228,593	152,299	48,610
Total	777,376	64,861	413,748	211,015	87,752
Percentage Distribution					
1–150	100.00	44.73	44.29	4.82	6.16
151–350	100.00	22.37	56.49	10.98	10.16
351–750	100.00	16.96	53.58	18.65	10.81
751–1,500	100.00	4.14	57.52	23.80	14.54
151–1,500	100.00	12.88	55.99	18.90	12.23
1,501–3,500	100.00	3.58	67.92	19.80	8.62
3,501 and over	100.00	1.56	45.53	40.82	12.09
1,501 and over	100.00	2.15	52.08	34.70	11.07
Total	100.00	8.34	53.22	27.15	11.29

Still further light upon conditions prevailing in the plants comprised in the inquiry is gained from an examination of the classification of workers. This is shown in Table 6, and a summary classification is given in Table 7.

TABLE 6: CLASSIFICATION OF WORKERS UNDER DIFFERENT SYSTEMS OF WAGE PAYMENT
(Source: National Industrial Conference Board)

System of Wage Payment	Workers in Plants				
	Total	Using Time Wage Only	Using Piece Rates and Other Incentives		
			Piece Rates	Piece Rates in Combination with Other Incentives	Other Incentive Systems without Piece Rates
Time Wage	367,454	64,861	180,133	90,047	32,413
Straight Piece Rate	218,321	..	181,008	37,313	..
Group Piece Rate	30,164	..	25,694	4,470	..
Piece Rate with Guaranteed Time Rate	38,061	..	26,891	11,170	..
Taylor Differential	1,040	..	22	1,018	..
Production Bonus	1,093	..	..	494	599
Standard Hour	697	..	..	3	694
Halsey Premium	9,953	..	..	3,812	6,141
Rowan Premium	226	..	..	..	226
Gantt Task and Bonus	5,222	..	..	4,219	1,003
Emerson Efficiency Bonus	9,252	..	..	8,567	685
Parkhurst	1,946	..	..	1,848	98
Bedaux	33,177	..	..	18,466	14,711
Haynes-Manit	551	..	..	407	144
Group Bonus	44,896	..	..	21,191	23,705
Miscellaneous	15,323	..	..	7,990	7,333
Total	777,376	64,861	413,748	211,015	87,752

TABLE 7: DISTRIBUTION OF WORKERS BY SYSTEMS OF WAGE PAYMENTS, 1928
(Source: National Industrial Conference Board)

System of Wage Payment	Number	Per Cent
Time wages	367,454	47.2
Straight piece rates	218,321	28.2
Other piece rates	69,265	8.9
Special incentive systems	122,336	15.7
Total	777,376	100.0

A little less than one-half of all the workers were paid time wages and most of these were found in plants having piece rates and other incentive systems in operation for part of the employees. It is interesting to note that 43% of all the workers in plants using piece rates and no other incentive plan were paid on the time basis. Where piece rates were found in connection with other incentive systems, the proportion of time workers was also 43%. In those plants which used other incentive systems but had no piece rates, the proportion was 37%.

Workers on piece rates form 37% of the whole number of workers in all establishments that reported. Most of them are employed on the straight piece rate, while about one-fourth of their number work under some modification of the straight rate. On the other hand, workers under the various specialized incentive systems number less than 15.7% of the whole number of workers in all the establishments to which the figures relate.

It is interesting to see how the 1928 inquiry differed from the one conducted five years earlier. Table 8 shows that there were fewer workers on time wages and a greater number under other incentive plans in the more recent of the two investigations. It is impossible to say whether this denotes a change over a period of five years in systems of wage payment or whether the difference results from the fact that the firms from which returns were received were not identical in the two periods.

TABLE 8: COMPARATIVE DISTRIBUTION OF WORKERS BY SYSTEMS OF WAGE PAYMENT, 1923 AND 1928
(Source: National Industrial Conference Board)

	1923		1928	
	Number	Per Cent	Number	Per Cent
Time wages	416,518	55.7	367,454	47.3
Piece wages	280,259	37.5	287,586	37.0
Other incentive systems	50,633	6.8	122,336	15.7

To ascertain to what extent the various systems were in use and where they were located was the first step in the inquiry. The next step was to ascertain the experience of the plants with the various systems. For this purpose detailed questionnaires were sent out in equal number to the plants reporting the use of time wages only and plants reporting a considerable use of piece rates. Questionnaires were also sent to 150 plants which employed some form of bonus or premium system.

CHAPTER I

THE TIME WAGE SYSTEM

THE original method of rewarding labor by a fixed rate per hour or per day is still used for the majority of workers in American manufacturing industry, and in other fields of employment is well-nigh universal. It is accepted as a matter of course by the majority of wage earners as well as of employers. Frequently, there is no definite measure of what a worker does other than the time spent upon the job. In other cases where the work is definitely measurable, it has not been thought worth while to measure what the individual worker accomplishes and to relate compensation to accomplishment.

Time Wages and Incentive Systems

The chief distinction between the usual time wage system and incentive systems is that the latter take definite and continuous notice of the amount of the output of each worker and base his compensation, in full or in part, directly upon the accomplishment of the individual or the group to which he belongs. This contrast does not imply that under no circumstances can the time wage as applied to industrial workers take notice of differences in the skill, ability and product of the individuals who compose the group. In a given occupation operators may be divided into grades A, B, etc., according to experience and a general estimate of their production capacities, and the different grades may receive different rates of pay. In such cases, however, the classification is usually made with reference to other characteristics of the worker as well as to amount of his output. The significant thing, however, is that within each group so determined the rate remains invariable, and that no effort is made to establish the variation in the output of individuals and base their remuneration upon it. In effect, such a procedure is simply a somewhat closer classification of persons

and occupations than usually prevails. It does not change the fundamental principle of the time wage.

Under the time wage the earnings of the worker are always those of the class to which he belongs; under incentive systems his earnings are affected by his hourly or daily record of work. Under the time wage system, the pay envelopes contain for each worker of a given occupation the same amount for a given time worked; under other systems the pay envelopes for any class of workers may vary widely in their contents as between individuals and from day to day. It is in these distinctions that the merits of incentive systems are found.

Criticism of the Time Wage System

In spite of the wide use of the time wage in American industry it has been the subject of much criticism. The general purport of that criticism, which may be examined in some detail, is that this system of payment as such does nothing to stimulate the worker to his best effort, that production accordingly lags and that costs of production are high. In elaborating these objections it may be assumed for the moment that the employer is in a position to adopt, if he will, alternative methods of wage payment, and that he has no other means of neutralizing some of the tendencies believed to be inherent in the payment of time wages.

Time Wages Said to Imply High Costs

The workers at any given process differ from one another in their production, whether because of differences in their individual capacity, in training or experience, or in their attitude towards their work. Even when, as previously suggested, they are split up into different classes receiving different time rates, within each class such individual differences persist. If all the individual workers in any group are paid the same time rate, and if each produces according to efficiency, the product of the least productive worker will be more costly than that of the most productive worker. If, however, those who are most efficient are not spurred on to exercise their efficiency, if they are content with smaller production than that of which they are capable, the output

of the whole group will be less and the labor cost of production may therefore be higher than would be the case if each worker were paid only for what he accomplishes.

Time Wages Said to Imply Low Production

Critics of the time wage system insist that the time wage slackens the productive effort of the best workers and fails to stimulate those who are less efficient. The flat rate for all workers under the time wage fails to induce men to put forth their best efforts. In fact, it often discourages them from so doing, and thereby results in a loss of potential production and in higher costs for output produced. There is, it is contended, an inherent tendency in this form of wage payment to make men lax in their effort, and to reduce for all workers the level of attainment to that of the least efficient worker whom it is profitable to employ.

Underlying this argument is the belief that men generally are disinclined to any greater activity than conditions compel, and that left to themselves will do little more than what they deem just enough to hold their jobs. It is argued that when numbers of men are employed at the same work, the pace is likely to be set by the slowest workers, the least efficient men whom the employer finds it worth while to keep on the payroll. The time wage system itself offers no compelling motive for abler men to exert themselves beyond what is necessary to keep up with these low-grade workers. No greater accomplishment will bear direct and immediate fruit in greater reward for their labors, and hence it is inferred that they will usually be content with a low standard of attainment. The economist has designated these workers of low efficiency as "marginal men," and using this phraseology, the contentions to which attention is here called may be summarized by saying that under the time wage system the average production of a group of workers tends to approximate that of the marginal workers.

Modern Conditions Said to Accentuate Defects

It is argued not only that the tendencies here noted go back to causes which lie deep in human nature itself, but that under certain conditions they are accentuated by the

modern industrial condition. That the worker has a tendency to adjust his work to his pay is perhaps no new development, but in the larger concerns of today it is probably more in evidence than in the smaller industrial units of a century ago. If this tendency prevails and can not be controlled, it has a deeper bearing upon productive efficiency when there is an expensive equipment whose economic utilization depends upon the speed of the work than when the equipment consists of few and simple tools.

Qualifications to Criticism

Those who criticise the time wage system on the ground that it tends towards a low level of accomplishment, with the implication that it contains no incentive for more efficient men to work to a higher level, would be the first to admit that their contentions represent a broad tendency in economic affairs and not an economic law. They would recognize the existence of counteracting tendencies which in individual cases might entirely overcome the general trend which they emphasize.

There are many motives which impel men to do the best of which they are capable. There is instinctive in many men a pride in craftsmanship and accomplishment, a feeling of satisfaction in work well done, and a desire to prove themselves the better workers, whether in the hope of material advancement or for their personal satisfaction.

Nevertheless, the position of the critics to which attention has been directed forms a convenient starting point from which to consider the characteristics of the time wage system. It is to be remembered that in any discussion of this nature it is not possible to consider simultaneously all the elements which enter into the situation. It is imperative to isolate the particular feature under examination. In the present case this is the method of paying wages, and the problem to be discussed is the inherent relation of different methods of payment to the efficiency of the workers, the amount of their compensation, and the labor cost to the manufacturer. When the results of this single factor are worked out, attention may be given to other factors which modify the conclusions reached.

Before examining the results of any hypothesis, it is necessary that it be clearly stated and understood. In accepting as a starting point for the analysis of wage systems the notion that under the time wage system the average production of a group of workers tends to approximate that of the marginal worker, it is important to examine whether the premise is a reasonable one. It is probably a mistake to assume that none will work any harder than the economist's marginal man. The position of such a worker is not an enviable one. Through ignorance or incapacity some never get any higher in the scale of efficiency; some slip into the position through indolence and are without ambition to get out of marginal employment, but no man deliberately seeks it. The better worker always strives to put a certain distance between himself and the marginal man. The distance may not be so great as he is capable of making it, but he wants a safe distance as a measure of protection, so that when poorer workers are discharged, he may hold his job.

In some cases the time wage worker is led to put forth greater effort than the poorest worker in the hope of special consideration of one sort or another, independent of any effect upon his wages. In other cases the superior worker renders efficient service as the surest road to advancement. This may mean transfer to another work classification, where the rate of pay is higher, or it may mean promotion to foremanship.

Tabular Presentation of Wage Systems

Just how the tendency toward a more or less definite level of production for all workers under the time wage system will work out in a given case, and what forces will fix the level, are matters in a large degree dependent upon circumstances. No general rule can be stated. Whether time rates will produce an adequate output, or whether it would be advantageous to adopt piece rates or some other system of wage payment will depend largely upon the particular situation to which the system is to be applied.

It is therefore important that any comparisons of time wages with other systems and of these with one another, such as is proposed in the present report, should refer to the same basic situation.

A hypothetical situation, which will permit the tabular presentation of comparisons of the various systems has accordingly been worked out in this connection. In assuming a situation to which various systems of wage payment might be applied, the main factors to be considered are two: (1) the grades of efficiency and (2) the distribution of workers among these grades. In both respects the situation, while not a photograph of actual conditions, should be a plausible one.

The choice of efficiency grades concerns their range and the steps from one grade to another. The range of possible efficiency in the actual operation of factories varies considerably for different occupations, depending in part on the degree in which the machine, rather than the man who tends it, sets the pace for the operation. It is assumed here for the basic situation that the range of efficiency among the workers is from 50% to 150% of an assumed standard. For the convenience of calculations it is assumed further that the efficiency of each group, proceeding from the lowest to the highest, is exactly 10% above that which precedes it. This of course implies a rounding off of actual efficiency which would not occur in practice, but which serves to facilitate computations.

The second factor of primary importance is the distribution of the workers among the different efficiency grades. For this purpose, a scale has been chosen which corresponds in its main features to the experience of one manufacturing concern operating under an incentive wage system. Here, again, there has been a slight rounding off of actual figures in order to simplify the presentation.

The basic situation for this study as regards the efficiency of workers and their distribution is presented in Table 9. This table will be used as a guide by which to exhibit the workings of time wages, piece wages and other major systems of incentive wage payments. It is to be understood that the emphasis of the treatment is not to be found in the positive results imputed to one system or another, but in the *method* by which these results are worked out. It is obvious that

TABLE 9: HYPOTHETICAL SCALE OF PRODUCTIVE CAPACITY[1]

To be used as a basis to show the operation of wage systems
(Source: National Industrial Conference Board)

Efficiency Grade	*a* Scale of Efficiency under Incentive Percent	*b* Potential Output per Unit of Time	*c* Potential Time per Unit of Product	*d* Distribution of Workers	*e* Potential Output per Group per Unit of Time
A	150	1.50	0.667	1	1.50
B	140	1.40	0.714	1	1.40
C	130	1.30	0.769	2	2.60
D	120	1.20	0.833	5	6.00
E	110	1.10	0.909	10	11.00
F	100	1.00	1.000	20	20.00
G	90	0.90	1.111	25	22.50
H	80	0.80	1.250	20	16.00
I	70	0.70	1.429	10	7.00
J	60	0.60	1.667	4	2.40
"Minimum" K	50	0.50	2.000	2	1.00
Total Potential Output					91.4
Average Output					0.9144

[1] This table and the ones which follow are based upon a series of large working tables in which all fractions were carried to five decimal places. In condensing them for representation in the text there has of necessity been some rounding off of such decimals. Consequently, any apparent discrepancies which might develop in checking the figures in the next tables will be due to this rounding off of decimals.

different conditions produce different results[1], and it can not be too strongly insisted that each particular situation is to be judged according to individual circumstances.

The construction of this table is fundamental to the discussion which follows, and it is highly important that it be thoroughly understood. Since its captions may not be entirely self-explanatory, nor the contents of its columns clearly obvious to those who examine it somewhat casually, a detailed description may help to a clearer understanding of the exposition to be based upon it. The table assumes a group of workers of varying degrees of efficiency designated by the letters A to K. The total number of workers is chosen for convenience as 100 and the numbers in each grade are indicated in column *d*. It must also be understood that for each of these workers the normal time wage is $10 per unit of time. These figures are used in working out the probable production, the labor cost per unit of product and the earnings of workers under the several wage systems to be considered.

[1] The effect of different distributions of efficiency on the operation of wage systems is treated in the Appendix of this volume.

From what has been said it is clear that such differences in efficiency as are indicated in column *a* are, under the time wage system, latent rather than obvious. If they are not called into play by some incentive decree, the potential output per worker and the total output for the group will not be realized. However, in order that the table may serve the purpose of discussing different wage systems, these figures are introduced upon the assumption that under the conditions of incentive systems generally the workers would produce according to the scale of efficiency[1] here indicated. Thus the worker A, of the highest efficiency, is assumed to do three times as much work in a given time as any worker in Group K. Accordingly, the table shows that he produces one and a half units of work in a single unit of time (col. *b*) or, conversely, that he requires for a single unit of work only two-thirds of a unit of time (col. *c*). The single worker in class A represents the maximum production efficiency; the other classes are successively less productive. As the series progresses from A to K, the amount of the output in a given unit of time decreases (col. *b*), while, conversely, the time required for one unit of work increases (col. *c*).

The distribution of the workers who compose the working force is given in column *d*, and the output of each group in units of work for each unit of time appears in column *e*. These columns will be found necessary in the later discussions of some of the more complex systems when it is sought to determine the labor cost of the product. This will be found by multiplying the piece wage of each group by the output of the group, or the time wage by the number of workers in each group, and adding the results. When the total labor cost of the output is thus obtained, division by the number of units produced will give the important figure of labor cost per unit, equivalent to the average piece rate.

[1] The capacity here stated represents not what is theoretically but what is practically obtainable. It is recognized that many factors determine what the operative can and will do. For example, the leveling tendency ascribed to the time wage system is not wholly absent under incentive systems. The fear that rates may be cut often operates to hold down production. There is often a tacit and sometimes an express understanding among the workers as to the maximum production.

Operation of the Time Wage System

Given the assumed situation under the time wage system in which each worker receives a uniform wage of $10 for each unit of time, the problem presents itself as to what will be the probable production and what will be the labor cost per unit. The answer to the question depends wholly upon the extent to which the latent productive capabilities of the workers are brought out and are reflected in their output of work.

By referring to Table 9 it is seen that if each man worked to the extent of his indicated capacity, the output would be 91.4 units of work in one unit of time, produced at a total cost of $1,000, or an average labor cost per unit of $10.94. But there is little probability that any such results would be attained under such an arrangement. There would be no motive for the more capable workers to exert themselves to the full extent of their ability, and they would be content to give in return for a $10 wage only what they considered $10 worth of work.

Purely for the purpose of illustration, it may be assumed that the tendency of workers under the time wage system to conform their production to that of the least efficient group operated without let or hindrance. In that case group K, which produces one-half a unit of product in each unit of time, would set the pace. At this rate each unit produced would cost $20 in labor, and the entire group of 100 workers would have an output of fifty units of product at a total cost of $1,000.

The assumption of the previous paragraph, however, ignores the fact already set forth, that while under the time wage system the production of each worker tends towards that of the least efficient worker, it probably never reaches so low a level. Even the theory in the case, it may be noted, places the level to which production tends at that of the lowest grade worker "whom it is profitable to employ," not the lowest who is actually employed. In a concrete application of the theory, the fact should not be disregarded that in practice some workers may be on the payroll who are below the grade of the economists' "marginal man." In the distribution of workers here assumed, some of the lower grades

might well be in this class, largely perhaps because they were beginners.

If, for example, it is assumed that groups K and J in the assumed distribution belong in this class of unprofitable or sub-marginal workers, it will be the group I worker, producing 0.7 units of product in one unit of time, who sets the pace. Under this assumption groups K and J will do their utmost, and these six workers will produce 3.40 units. All other workers, ninety-four in number, producing at the rate of 0.7 units of work in a single unit of time, will have an output of 65.8 units, making a total output for the 100 workers of 69.2 units. As before, the total labor cost of the output will be $1,000, but the labor cost per unit will be $14.45.

With the given distribution of workers the possibility of even more favorable results for the manufacturer is not excluded. It might well be that systematic and rigid supervision of workers or the setting of minimum tasks might induce even greater productivity, and that group H, with a production of 0.8 units of work in a unit of time, might be the pace setters instead of group I. In that case the workers in the three lower group, sixteen in number, would produce an aggregate of 10.40 units, while those in group H and above, eighty-four in number, producing at the uniform rate of 0.8 units of work in a unit of time, would have an output of 67.2 units. The total output would therefore be 77.6 units produced at a total labor cost of $1,000 or $12.89 per unit.

The range of production here noted between 50 units in the lowest and 77.6 units in the highest case, and the range of labor costs per unit from $20 to $12.89 represents some of the possibilities which may exist under the time wage system with a given distribution of workers.

Securing Efficiency with Time Wages

The present discussion is designed to bring out, if possible, the relation of systems of wage payment to productive efficiency in industry and does not concern itself except incidentally with other factors in administrative management which may promote efficient operation. It can not, however, be overlooked that productiveness in industry is not linked exclusively to any system of wage payment, but depends

upon many factors. No system of wage payment of itself will necessarily produce either efficiency or inefficiency. If, for example, a system such as the time wage system tends towards inefficiency, high costs and low production, these tendencies may in considerable part be overcome by an intelligent factory administration. Other systems which it is contended are likely to promote efficiency, increase production and lower costs may fail altogether to do so if they are unintelligently installed and laxly administered.

Under the conditions of the problem, as has already been pointed out, a careful administration of the factory might bring it about that, without eliminating inferior workers, those of a higher grade might be induced to set the pace for the work of the factory as a whole. How far this process could go is problematical. At current wages and in the absence of other inducements there is no reason to suppose that one plant could maintain a standard of production that was materially higher than other plants in the neighborhood. Somewhat more than average production might be attained in an establishment which was able in one form or another to offer special inducements to the workers.

In the course of the following treatment it will be observed that the objective of other systems of wage payments is to secure and retain, if possible, a personnel of relatively high efficiency and to make it profitable for each employee to exercise as nearly as possible his full productive power. It will be seen that this result is attained in part by the systematic education of the workers employed, but it is secured in perhaps larger measure by selecting for employment workers of higher capacities.

Within limits the selective process may operate to draw into a factory operating under the time wage system a body of superior workers, and to obtain a volume of product which reflects, in part at least, this labor superiority. This process may work itself out without any increased wage outlay. At current rates of wages, employment conditions in a given factory may enable the manufacturer to secure the pick of the workers. The factory may be new and well lighted, its sanitary conditions may be of a superior character and the reputation of the management for square dealing may be such

that workers, even though its discipline may be known to be somewhat strict, will regard it as a good place to work and will give it the preference over other shops. Under such conditions the manufacturer might be able, in a working population graded as in the basic illustration, to eliminate altogether from employment groups J, I, H and employ only workers of the grade G and upwards. If, under the terms of the general analysis of time wage systems here given, it was the group G which set the pace not only for itself but for classes of higher potential output, the output per 100 workers would be 90 units, and these, being produced at a cost of $1,000, would represent a unit cost of $11.11. This figure is lower than any of the preceding illustrations, first, because workers of a higher grade set the pace, and second, because through the selective process all workers inferior to the pacemakers are eliminated.

How far these non-financial advantages might assure to the manufacturer a constant supply of labor of the higher grade willing to work at a more productive rate can not be determined. It is, however, certain that such results would be effectively secured if financial considerations were added to the other factors. If the prevailing rate of wages is $10 per unit of time, a manufacturer offering $11 per unit of time would be in a strong position to command the services of the more productive employees. If such an added wage enabled the manufacturer, under the terms of our illustration, to employ only persons of the grade F and above, and if all workers produced at the same rate as those in group F, the entire group of 100 workers would produce in one unit of time 100 units of product at a cost of $1,100. The unit labor cost under such conditions would be $11, or less than any of the preceding illustrations although the wage rate was higher.

The suppositions here made are by no means fanciful. One of the most prominent manufacturers in the United States advocates and puts into practice the payment on the time basis of wages considerably above the usual rate, and finds it profitable to do so. In this case the speed of operations depends in large measure on the speed of the machinery. The worker must keep up with the machine, and to do so requires a productive effort considerably greater than is re-

quired for similar labor in other shops. Inferior workers know that it is useless for them to apply, and only the best in each field have a chance to earn these higher wages. Even among such highly skilled workers the strenuous effort often becomes irksome and they drop out because they prefer the more easy-going methods of other shops even at a lower wage.

Flexibility under the Time Wage System

In the discussion of the time wage system it seems to be taken as a matter of course that all workers in a given occupation should receive the same wage. This is perhaps true in most cases but it is not necessarily an invariable rule. It has been pointed out that workers in a given occupation might be classified into two or more grades. In some cases such a grading may be made upon the basis of accurate records of work performed; in other cases it may be fixed on the basis of experience and other factors which measure roughly a greater or less efficiency on the part of the individual worker. The result of such a classification is the establishment of a series of rates each applicable to a group of workers. If the views previously set forth in regard to the pace makers under the time wage are correct, it follows that each of these groups will tend to have its pace of operations set by the workers of lowest efficiency within the group. This conclusion is of course subject to the modifications respecting the least efficient workers in the group as a whole, to which attention has already been called.

The tabular statement will aid in showing how these principles might work out in practice. It was suggested that under the most favorable conditions the workers of group H might set the pace, with a resulting output of 77.6 units at a total labor cost of $1,000 or $12.89 per unit. A recognition that workers of higher potential efficiency than class H might be induced to exert their full powers, if given suitable financial compensation, might lead to the introduction of classified rates based on these known differences in efficiency. Let it be assumed that in this situation three rates of pay are introduced: (1) the general rate of $10 per unit of time; (2) a special rate of $11 per unit of time for all workers who attain the efficiency level of group G; and (3) an extra special rate of $12 per unit of time for those who reach the efficiency level of group E. What results might be expected?

Groups H to K will continue as before to produce at their maximum efficiency, groups G and F will produce at the efficiency rate of G, while the other groups will produce at the efficiency rate of E. In tabular form the results would be as follows:

Efficiency Grades	Number of Workers	Output per Unit of Time[1]	Total Output	Wages per Unit of Time	Total Cost
H to K	36	varied	26.4	$10.00	$360.00
G and F	45	.90	40.5	11.00	495.00
E to A	19	1.10	20.9	12.00	228.00
	100	..	87.8	..	$1,083.00

[1] See Table 9, p. 16 of this volume.

It will be seen that under these conditions a total product of 87.8 units might be produced at a cost of $1,083, or $11.20 per unit. Thus it will be seen that through classification of the workers an increased product is obtained at a decreased cost per unit. At the same time nearly two-thirds of the workers enjoy a better income than before.

It is evident that the introduction of the principle of classification renders the time wage system more flexible and gives to employer and wage earners some of the advantages usually credited exclusively to piece rates and other incentive wage systems.

Substitute Incentive Systems

This review of the operation of the time wage system leads to the conclusions that the advocates of substitute systems have painted too darkly their picture of conditions under time wages. It has seemed wise, therefore, to examine the time wage system in some detail, first, because the time wage system is the rule and other systems the exception, and second, because the processes of production do not always permit the substitution of other systems for it.

Limited Field for Application

Whether or not any substitute for the time wage can be adopted for any given industry or occupation, depends on

whether the individual worker's contribution to the product can be definitely measured in terms of physical units. It may be broadly stated that there is no manufacturing establishment in which this is true of every worker. Work of an administrative and supervisory character, and many other services such as those of watchmen and the like, together with much common labor, can not be so precisely measured. There are industries, however, in which a considerable part of the workers might, if so desired, be paid upon a quantity basis; there are others in which such a basis could be applied to comparatively few, if any, of those employed. Oftentimes, however, it is found that while not generally applicable to operatives of a given factory, certain services or processes may lend themselves very well to incentive systems.

Any argument adduced for incentive systems must be judged in the light of whether conditions permit the use of such systems.[1] None of these systems is to be considered as a substitute for the time wage generally. When such a system is proposed for a given industrial establishment, the burden of proof rests upon its advocates to show first that it is applicable to the given conditions and second that its adoption would prove beneficial.

Testimony on Merits of Substitute Systems

In like manner any testimony with regard to the benefits derived from the use of incentive systems must be interpreted as applicable to a given situation. That in many cases good results have followed the abandonment of the time wage system and the adoption of an incentive system is shown in the quotations which follow. They are drawn from the replies of manufacturers to the questions of the National Industrial Conference Board, and give the reasons for adoption of some form of incentive system:

> "To increase production, decrease unit costs and help build an efficient and contented working force."
>
> "To increase production, thereby reducing cost of production by securing larger quantity per hour for same overhead costs."

[1] The scientific study of productive processes and the analysis of jobs have demonstrated that the field for the application of definite measurement is much more extensive than would appear to the casual observer.

> "To get a greater production with the same amount of space and equipment and compensate the men for the extra effort."
>
> "To reduce cost and increase production with present plant and equipment: also to better satisfy the employees through their increased earnings."
>
> "To secure reduced costs without decrease in income to workmen."
>
> "As an effective method to increase production, give the better men the opportunity of being compensated for their increased skill and application and because of simplicity in accounting."
>
> "As the best means of giving value received for the amount of labor performed."
>
> "To keep costs at an even basis and reward good workers."
>
> "To enable us to increase wages without increasing costs."
>
> "To increase our production and lower our costs, and at the same time overcome the problem of labor shortage which existed at the time. It has done all this."
>
> "To try to maintain wage levels by securing lower cost through increased production."
>
> "To pay workmen according to their worth—to stimulate the efforts of foremen and all direct supporting non-productive labor, and to reward them in keeping with their efforts."
>
> "To enable the good workmen to increase his pay and encourage the poor workman to improve himself."
>
> "To increase the efficiency of management."
>
> "To break up the flat rate for the various classes of workers. This is the surest preventive of strikes and discontent. When all are paid one rate, it is the simplest and almost the inevitable thing for all to unite in the support of a common demand. When each worker is paid according to his record there is not the same community of interest. The good worker who is adequately paid does not consider himself aggrieved so willingly nor will he so freely jeopardize his standing by joining with the so-called 'Marginal Worker.' There are not likely to be union strikes where there is no union of interest."

The single reason most frequently mentioned (137 out of 174 instances) by plants for their adoption of systems other than time wage was "to increase production," implying, of course, the use of the same plant and equipment and labor force. This means "more economical utilization of the expensive factors of production," and was specifically recognized by fifty plants, which gave as their reason "to reduce costs."

The second most frequently mentioned object for the introduction of these systems (55 plants) was "to give the workers an opportunity to increase their earnings."

Relation of Time Wages to Other Systems

The foregoing statements seem to substantiate the claim that incentive systems insure a higher productivity of labor. But the main emphasis in the testimony is that such systems give the employer an increased production and a better control over output. It would push the contrast of systems too far, however, if it were inferred that under the time wage system control of output is impossible or that the employer is indifferent to it.

In the selection of employees and in the supervision of labor, ways and means can be found to insure a relatively high productivity of effort, even where the results of that effort can not be directly measured. The time wage system, in other words, does not render it inevitable that the employer should tolerate inefficiency.

Where a definite measurement of the work of each employee is possible, such a record is often minutely kept, although it may not be made the direct basis of wage payments. Such a record serves frequently as a measure of control; it forms the basis of classification of workers according to ability and plays an important rôle in promotions. Indirectly such a record may measure compensation for classes of workers rather than for individuals. Incentive systems, on the other hand, determine the compensation of individuals, and in so doing automatically furnish the element of control and stimulus within the system itself.

Time and product are coordinate elements in the remuneration of labor and can not be separated. The employer who pays by the hour expects that a reasonable number of pieces will be completed in that time. Likewise, the employer who pays by the piece expects that a reasonable number will be finished in any given time. The product is not indifferent under time payments, nor is time indifferent under piece payments. Labor efficiency is essential to productive efficiency. With the expensive machinery and elaborate equipment of modern industry, inefficiency among the workers is a clog upon management. Whether through incentive systems or otherwise, means must be found to eliminate inefficient workers if production is to be profitable.

The time wage is the most widely used system of payment

and time is, in fact, the basic wage element. For example, it is only when translated into time earnings that the piece wages in different occupations can be compared. It is only on the basis of earnings that wage rates under incentive systems can be compared with time wages.

Because of this fact all incentive systems are in essence adaptations of the time wage. It is by reference to the time wage in the same or in similar occupations that their reasonableness is measured. Employers would find it impossible to introduce these systems unless they assured a compensation at least as good as the time wage to the ordinary worker and gave to some the promise of a still greater compensation. The detailed study of the various systems and the experience of manufacturers with them will bring out more clearly, both the differences and the likenesses of time wages and incentive systems.

CHAPTER II

THE PIECE WAGE SYSTEM

IN so far as the time wage system may fail to adjust with sufficient accuracy the reward of labor to the degree of productive efficiency, and hence may fail to furnish the worker with an incentive to effort, a motive is found for the adoption of various so-called "incentive" systems. The earliest of these, known and applied for many centuries, is payment by the job or by the piece. Under the piece system if the output is large, the reward is large; if small, the reward is correspondingly small; that is, reward is commensurate with product. The natural incentive to productive effort has full scope.

Relation of Piece Wages to Time Wages

While, as pointed out in the preceding chapter, time and product are not independent of each other, piece rates can not be derived directly from time rates. It might appear at first glance that where the total time of a group of workers under the time system and the number of pieces they produced were known, it would be a simple matter to fix a piece rate upon the basis of average production. The employer, it might seem, would be utterly indifferent under such conditions whether labor were paid by the hour or by the piece.

The matter is, however, not so simple. Because the conditions which prevail under the time wage system are in many respects different from those expected from the piece wage system, no mathematical rule can be stated by which one can be transformed into the other. A rule must be adopted which will produce the desired result and this rule will vary greatly according to circumstances. The general purpose from the manufacturer's point of view is to secure a reduction in the unit cost of manufacture. Such a reduction is usually

accompanied by increased payments for labor. These, however, must be so adjusted that the ordinary worker receives as earnings a sum equal to, or greater than, the previous time rate, while those of more than ordinary capacity receive notably increased earnings.

Deriving the Piece Rate from the Time Rate

Referring back to the basic Table 9, on page 16, it may be assumed that the establishment of piece rates brings out the full productive capacity of each worker, a result which the time wage failed to accomplish.

In the discussion of time rates it was assumed for the purpose of illustration that the level of productive effort might conceivably be set by the workers of the lowest grade of efficiency, namely, those of class K, who produced one-half a unit of work in each time unit. This meant, as was pointed out, a production of 50 units of product by 100 workers at a uniform time wage of $10 and at an average labor cost of $20 for each unit.

Under the assumption stated, and with no other facts available, a piece rate based directly on these data would be $20 per piece. What would be the results of such a rate? These may be considered in terms of product, costs and earnings.

The stimulus of new rates is assumed to furnish adequate incentive for each worker to do his best. Each would produce according to his potential efficiency (col. *a*) and would produce in each unit of time a corresponding output (col. *b*). The output of the entire group of 100 workers in each unit of time (col. *e*) would be 91.4 units.

Each of these units of output would be produced at a direct labor cost to the employer of $20, just as under the time wage system. While the manufacturer would gain nothing in the matter of direct labor cost, he would expect some reduction in total costs, since for a given unit of time his overhead, presumably not affected by increased production,[1] would be spread over a greater number of units of product.

As to earnings the change to such a piece rate would un-

[1] A discussion of costs under piece rates and other incentive systems which takes cognizance of total shop costs, including material cost and machine rate as well as workmen's earnings, will be found in D. S. Kimball's "Principles of Industrial Organization," New York, 1925, p. 21ff.

doubtedly be a boon to the workers. Average earnings would increase from $10.00 per unit of time to $18.28, and with the exception of the small group (K) of least efficient workers all would participate in this advance. The best worker A would see his earnings rise from $10 to $30.

But, as has been seen, the foregoing assumption probably does not represent what actually happens under the time wage system. It is indeed more than likely that even without any special effort on the part of the employer to discourage soldiering it will be operatives of a rank higher in efficiency than the lowest grade who set the pace for the shop. It was suggested that this might be operators of the class I, who produced at the rate of 0.7 units of work in one unit of time. This assumption led to a computed total output of 69.2 units produced at a labor cost of $1,000 or a labor cost per unit of $14.45.

If such a state of affairs existed, the direct conversion of the time rate into the piece rate would give quite different results. The indicated piece rate is $14.45 per piece. Again assuming that the incentive of the piece rate brings out the full productive efficiency, the result would be a product of 91.4 units at a cost of 91.4 times $14.45 or $1,320.73.

Under such an assumption, as under any scheme in which actual labor costs under the time wage are converted into piece rates, the manufacturer gains nothing in the reduction of direct labor costs per unit, but must look for his gain in the reduction of total costs. The average earnings of the workers under a piece rate of $14.45 rise from $10 per unit of time to $13.21, but not all the workers participate in this increase. For workers of class I the earnings per unit of time become $10.11 instead of $10, those of class J are reduced to $8.67 and those of class K fall to $7.23. Of one hundred workers ten have no appreciable benefit from the change and six have their wages reduced. On the other hand, eighty-four have their earnings increased. This increase amounts to $1.56 per unit of time in the case of class H and to $11.87 in the case of class A.

These illustrations point to the following conclusions: (1) a conversion of the time rate based on actual production (whether this accords with the theoretical production or is

superior to it) will usually bring an increase of product; (2) manufacturers' direct costs will not be reduced but total cost will be; (3) the most proficient workers will increase their earnings in all cases, while the higher the piece rate the greater the number of workers who will increase their earnings; (4) under any rate less than that based on the production of the lowest grade workers employed, some of the workers will suffer a loss of income, and this number will increase as the piece rate is lowered.

Adjusting Piece Rate to Desired Cost Reduction

The elements which enter into the cost of a manufactured product are many and varied. For the purposes of this discussion only direct labor costs will be considered. Through the pressure of competition, through the desire to extend his markets, or for other reasons; a manufacturer may reach the conclusion that he must cut his labor costs, and may turn to a change from the time to the piece rate as a means of so doing.

For the purpose of illustration it may be assumed that under the time rate he gets no more than the production based on the lowest grade employed. Under the conditions stated in Table 9, this means the production in a given unit of time of 50 units of product at a cost of $20 each. He may figure that a reduction in unit cost to $15 is necessary, and fixes this as a piece rate. He knows that his workers have a potential capacity of 91.4 units. The only question before him is how such a change will affect the earnings of his workers, and whether he can in fact make the transition and retain the good will and cooperation of his employees.

A piece rate of $15 would require for the production of 91.4 units an outlay of $1,371, and this would mean average earnings of $13.71. Those in the two lower classes in efficiency would lose money, class I would have a negligible increase, class H would enjoy an increase of $2, and the highest class A would get an increase of $12.50 per unit of time.

Adjusting the Piece Rate to Earnings

The problem of fixing the piece rate may be approached from another angle, namely, that of the workers. It was said

that in changing from a time wage to a piece wage, payments under the piece wage system should give the ordinary worker as much if not more than under the time wage. Who is the ordinary worker? A reference to Table 9 shows that in one unit of time the given 100 workers can produce 91.4 units of product. Is the ordinary worker one who produces 0.914 units? According to the scale of efficiency given in the table, the nearest rating is that of the worker who produces 0.90 units, and for the purpose of illustration this group may be taken as the ordinary workers.

If the piece wage be fixed so that this group can earn its former time wage, it means a piece rate of $11.11. What effect would the adoption of such a rate have upon the earnings of the workers individually and as a group? As 91.4 units are produced at a cost of $11.11 each or a total cost of $1,015.45, the average wage would be $10.15. This small average increase inures only to the groups which exceed group G in efficiency. Group A would receive $16.66 and group F $11.11. But these groups comprise only 39% of the workers. One-fourth of 25% would remain stationary in their wages, and 36% would have their wages diminished.

It is possible that the rule stated before, that the ordinary piece worker should have at least as much as under the time rate, contemplates a different determination of the ordinary worker than that adopted here. It is obvious that the outcome of the foregoing calculations would be entirely unsatisfactory to the workers.

Perhaps a safer rule to follow is that the ordinary worker should receive more under the piece wage than the time wage. How much more this should be depends on a variety of circumstances, but the testimony of practical men is that it should be not less than 10%, and in some circumstances 30% is recommended.

For the sake of illustration these rates may be applied to the familiar figures of Table 9. Again class G, with a product of 0.9 units of work in a unit of time, may be considered to represent the ordinary workman. Under the 10% rule his time earnings under piece wages should be $11. This means a piece rate of $12.22, a total labor cost of $1,116.90, and hence average earnings of $11.17. Class G would, by the

terms of the proposition, have its time earnings increased by $1, but the increase for Class F would be $2.22 and for Class A, $8.33. Class H would find its earnings cut by 22 cents in each time unit, while classes I, J and K would suffer greater losses in earnings. In short, this rule would increase the earnings of 64% of the workers, reduce those of 20% by less than 5% of time wages and make greater reductions in those of 16% of the whole number of workers.

Under the rule of increasing the earnings of the ordinary worker 30%, the time wages of Class G would become $13 and the corresponding piece rate $14.44. This rate would mean a total labor cost of $1,319.82, or average wages of $13.20. An increase of earnings would be secured not only by Class G and those above, but also by Class H, who would gain $1.55 for each unit of time. For the workers in Class I, who would gain 10 cents more per unit of time, the change would be negligible. Group J would be reduced to $8.66 and Group K to $7.22. In short, fixed in this manner the piece wage would increase the earnings of 84% of the workers, would leave practically stationary those of 10% of the workers, and reduce those of only 6%.

Composite Adjustment of Piece Wages

The working out of these various hypothetical piece rates has served one purpose, in that it has demonstrated more forcibly than any emphasis of assertion could have done that there is no one rule which determines the relation between time rates and piece rates. The determination of a just piece rate is a composite of many factors some of which have already been noted, though others are of equal importance. One is the nature of the work to be performed and the degree in which the different efficiencies of the workers may be expected to result in differences in the product. In Table 9, for example, efficiencies have the wide range of from 50% to 150%. It might well be that for a given activity the range of possible efficiencies would be much smaller, say from 75% to 125%. Not only the range of efficiency but the distribution of the workers within this range is also a matter of moment. All of these things and many others must be taken into consideration if a workable piece wage system is to be established.

Field of Application of Piece Rate System

Since different products are not directly comparable per unit in regard to the kind, quality and quantity of labor involved in their production, piece rates can not be general but must be specific. Each product, possibly each part of the product or each process in the production, requires a specific rate. If rates for different tasks are identical, it should be the result of chance, not design. The piece wage system, as a rule, must thus be confined to clearly defined uniform products produced under uniform conditions.

Limitations to the Piece Rate System

The definition given indicates rather narrow limits for the piece rate system. Indeed, there may be rate cases which fall under the definition given, but in which the piece wage system is unsuited or not worth adapting. This occurs when the work is so highly mechanized that there is no room for play of the human element. The worker simply becomes part of the machine; no increase or decrease in output can be brought about by his own efforts. Under such circumstances time signifies volume of output just as directly as number of pieces.

Moreover, the piece rate system is, in general, worth while only when the volume of output is sufficient to justify the trouble of determining the appropriate rate and to afford the operator some expectation of improving his efficiency. The evidence of employers who have adopted the piece system points out many limitations to its application.

It is not, in the general opinion, applicable to what is sometimes called "non-productive" labor, office help, supervision, inspection and testing, and similar tasks.[1] It has, as a rule, been found unsuited in the manufacture of custom-made articles, specialities and small quantities, experimental work, and articles where "quality" is of first importance. From the evidence submitted it appears that it can not be applied successfully to repair work, assembling, trucking, the stock room, pattern making, or to common labor, which is constantly shifted from one job to another. Finally, it may be added, it has been found unwise to introduce the piece wage where the saving in labor and use of equipment is likely to be more than offset by waste of costly materials. Some pertinent expressions to illustrate these limitations may be selected from the opinions of manufacturers:

> "It is cumbersome, ineffective and unjust to attempt to apply piece work to small jobbing businesses where the quantity of orders is small."
>
> "Only applicable where an operator is kept steady on one kind of machine."
>
> "Piece work in our opinion can only be used where the volume in the class of work is sufficient to allow the operator to reach the highest efficiency."
>
> "We should question the value of piece work unless the work is repetitive and the quantity of production is reasonably large."
>
> "There are limitations—small quantities, necessity of moving workers from job to job frequently, material from which pieces are made (irregular in quality) causing variation in amount of work necessary to get same results on like prices."

From the plants that have not adopted any incentive schemes, or have tried them and found them unsuitable, the testimony confirms the views above expressed. Managers of many of the plants, indeed, frankly stated that they had never considered any other system than the straight hourly pay—evidence, perhaps, that the disadvantages of the time wage were for them not serious. Most of those that had rejected incentive plans in favor of the time system gave as the reason their small output of specific articles and the variety of their product:

> "We receive many orders for special goods which are run through in small lots."
>
> "We have considered every system of which we know and are of the opinion that the straight hourly rate is the best for any plant having short runs on a multitude of different pieces."
>
> "We have over 20,000 list numbered parts to make and very few of them in large quantities."

[1] These limitations are not universally conceded. Instances are cited in which excellent results have been obtained in many of the fields of work above noted. With regard to inspection, its value would seem to be measured not by the number of articles turned over but in the detection of defects, a less easily measurable function. This being the case it would appear that piece wages for the inspector would defeat its own purposes. Yet there are those who believe that "by checking the work of the inspector a bonus may be paid for quantity, and that such a check acts as a penalty to him, just as his check to the piece worker acts as a penalty to the latter."

"We haven't enough of any one article to manufacture to install piece work system, but hope some day to reach that situation."

"We have about 100 different kinds of machines . . . and each of these can be changed slightly all the time to suit each individual customer. In other words we have tried to get out standard equipment, but competition will not let us."

"We manufacture a product all the component parts of which must be accurate within a thousandth of an inch. For this reason piece work of any character would involve the installation of very elaborate inspection processes after each manufacturing operation."

"Wages represent approximately only 12% of our manufacturing cost, therefore we would prefer to have our men take all the time necessary to turn out a high quality product rather than to hurry through on a piece work basis."

"The material cost of brass goods is so high that a molder earning $8 a day, in an effort to increase his wage, can by careless, hasty work cause the brass castings to come over weight and so waste up to $15 a day in metal."

Limitations of Piece Rates Sometimes Exaggerated

A few of the plants stated as their opinion that "any work that can be done on day rate can be done better on piece rate," that "piece work can be worked out in any size plant and in any business," "piece work can be worked satisfactorily in any plant," "piece work or its equivalent is applicable to any and all forms of work." A more moderate statement is the following:

"I do not believe there is any one system that would produce best results for all plants, all types of labor or all kinds of products."

One can certainly go so far as to agree, however, that by slight changes in method, division of labor, or other devices, piece wages can often be introduced for work for which at first it appeared unsuited. The following experiences will illustrate:

"For years in our plant it was believed impossible to put our plating room on a straight piece work basis. The feat has been accomplished within the last six months with huge success, reducing our overhead to almost nothing, increasing our production largely with half of former force without disturbing quality of work."

"We truck goods from one department to another, unload lumber from cars and have gang piece work as well. Our men object to working on a day rate. There is no way of paying a man better than to pay him for the work he has done."

"On some operations where piece work was not the rule at one time, when it was introduced we found that it worked with amazing clarity and satisfaction both to ourselves and the worker."

Advantages of the Piece Wage System

Where the adoption of the piece wage system has been successful in overcoming certain disadvantages of the time wage, it has increased the output, increased the employee's earnings and decreased unit costs. Among those companies reporting definitely on these points, output had been raised anywhere from 10% to 400%, with 30% the median or middle point in the series; earnings had increased from 10% to 100%, the median being 25%; and unit costs had been reduced from 10% to 50%, the median being 21%. One manufacturer stated:

"We should need a plant and force two-thirds greater than our present ones to produce the same results if we operated by per day or per hour basis."

There was also testimony to an appreciable reduction of labor turnover, indicating greater satisfaction on the part of the workers:

"We know the piece work system has reduced labor turnover because if a man is earning good pay he is much more apt to stay than if he is earning small pay."

"Very appreciable reduction in labor turnover has resulted from piece work."

With regard to absenteeism and tardiness, opinions vary. This is indicated by the following expressions:

"It could hardly be claimed that increased earnings had the effect of reducing absenteeism and tardiness. These are controlled by other regulations, and by the use of premiums and penalties."

"We believe (with regard to absenteeism and tardiness) that piece workers, particularly on unskilled and semi-skilled work, have a greater interest in their job than would day workers. Men paid for what they do are less apt to be tardy than those paid by the day."

"In departments where it was 5 to 15 minutes after the whistle sounded before the department was in operation, we now find the department working even before the whistle sounds."

Disadvantages of the System

While the piece wage system has generally been applied successfully as an incentive to increased output, and has brought increased earnings for the worker and reduced labor cost per unit, it has not been found without disadvantages, at least under certain conditions. The foremost of these objections to the piece system arises from the *indirect* relationship of piece rates to time wages explained above. A primary difficulty lies in fixing the original rate in such a manner as to be just to all concerned, and minimizing as far as possible subsequent rate cutting. Rate cutting, indeed, has been practiced to such an extent in the past that the "piece system," where not already well established, was often viewed as labor exploitation.

Difficulty in Establishing the Original Rate

The difficulty confronted by the manufacturer in transition from the time wage to the piece system, where piece rates are not already established and quoted in the labor market, is serious. On the one hand, if he converts the actual wages directly into piece rates, it is highly probable that the rates will sooner or later have to be cut, especially upon the first depression in the market. If the piece rates resulting from converting time rates on the basis of the usual product do not apply to all the workers in the plant, some groups may make earnings quite out of line with the compensation appropriate to that grade of labor. If low grade workers receive more under the piece wage than the time wage for highly responsible work, discontent is sure to arise among the less favored workers.

Some manufacturers, in their replies to the questionnaire, stated frankly the view that when earnings under the piece system are very high, it is *prima facie* evidence that the piece rate must have been set unduly high, either through a mistake in the estimate of normal output in the given unit of time or because the time rate on which it was based covered excessive "soldiering" on the part of the worker. On the other hand, if the manufacturer in shifting from time work to piece rates sets the latter below those which would result

from the relation of actual production to current time rates, the worker, computing his earnings from the proposed piece rate on the basis of the output to which he is accustomed, objects that the rate effects a reduction in his earnings, and that the adoption of the piece system is simply a method of exploitation.

The policy actually followed by manufacturers appears from their replies to be a compromise. All except one of the plants using the piece system agreed that the piece rate should be set to enable the worker to earn more than he had earned under day work. Few indicated just how much more, but seven plants estimated that the worker should earn 10% to 25% more, eleven that he should earn 25% to 33%, and one plant gave 50% as the desirable increase.

> "A day rate is first set and used on special jobs. The piece work rate is 10% above the day rate."
>
> "To enable the worker through reasonably intense application to earn approximately 30% more than time work. (This does not result in physical breakdown.)"
>
> "The ideal condition is attained when from 10% to 20% more is earned by piece work than the current day rate for same class of work."
>
> "While 20% is the theoretical basis, experience shows that best men increase to 40%."
>
> "The margin over hourly rate should be fixed in proportion to the severity of the task. If the operation requires little more than the presence of the operator, a small increase is sufficient, if the demand for either physical or mental effort is great, the margin must be high. No uniform margin should be adopted. It may run from 15% or 20% up to 50% or 75%."

Rate Cutting

Setting the original rates too low breeds discontent; setting them too high may have a like result through the necessity of their subsequent reduction. When rates have been established which insure to certain classes of workers earnings in excess of what work of such a nature commonly receives, some manufacturers feel that the rates should be cut at once. Others may be disposed to wait till such action is forced upon them by competition or other business conditions.

When, with an increased volume of production, it is found necessary to lower prices, to incur disproportionate additional

expenditure for advertising, to employ a larger clerical force, to extend more liberal credit to purchasers, etc.—expenses more than offsetting the economies under piece work in the utilization of plant and equipment—it may be advisable and assuredly would be reasonable to reduce the excessive earnings of the employees to a level more nearly approximating the general market rate for the given type of labor.

In either case the worker is aggrieved. It seems to him that the manufacturer has waited for him to push up his production, with the express purpose of cutting the rate and putting him back where he was at first so far as earnings are concerned, while requiring him to work under more severe tension.

Changes in Process Necessitate Rate Modification

While accuracy in determining a fair output for a given period of time may help to avoid the rate cutting which often ensues from setting too high a rate in the beginning, it does not, of course, reach the problem of rate modifications arising from changes in processes or in machines used. The worker who has become proficient with one machine or under one process of production may find himself suddenly reduced to the position of a beginner starting on the new machine at his base wage. Under the time wage system, hostility to the introduction of improved methods and machinery is always serious, even though the employee may continue to receive the same wage as before. There is a natural inertia to be overcome; the worker dislikes to learn anything new, and he may fear that his position becomes insecure, that he is likely to be dropped on the next market depression. All these difficulties are enhanced under any incentive scheme, since the worker is automatically deprived of his customary additional earnings. The very advantage of the incentive in stimulating proficiency increases the reluctance of the worker to leave the task in which proficiency has been gained. On the other hand, in order to maintain plants at the highest efficiency, manufacturers must feel free to make changes in the internal operations of the factory—to introduce new machines and new processes, to shift labor from one task to another, and to make any other necessary adjustments.

In general, manufacturers expressly reserve the right to change rates upon the introduction of new machines or a new process. However, in order to protect the worker who is shifted to a new task upon which he is not yet proficient, manufacturers using the piece system often guarantee a minimum day wage for at least a time. This practice is evidenced by the following quotations:

> "When he is new on the job this is done. When he has had a chance to get proficient on the work he must make good or be moved to some other job or quit."
>
> "The least he can earn is his day rate, which is usually approximately 10% below his base piece rate."
>
> "We give him plenty of time to learn and when he goes on piece work he takes his piece work earnings."

Some plants provide that, when a new machine is introduced, the worker shall receive the average compensation (basic wage plus bonus) he has already been earning. Only after he has learned the new machine will the appropriate standard output and scale of bonus payments be applied. This plan does not apply to new employees, who begin with the standard rates. In one instance, replies to the questionnaire disclosed that this device was used in lieu of a reward for a suggestion to promote the improvement of machinery or processes. The arrangement was to the effect that where installation of a new machine or dies, or a new method of handling comes from the suggestion of a man engaged in the particular run or operation, the rate is left the same for him just as long as he remains in employment. Where several men are working on the same operation, only the one responsible for improved methods retains the old rate. The others take the new rate.

This measure aims to stimulate improvement, and to allay complaint against the incidental disadvantages resulting from improvement, by allowing the worker to share directly in the beneficial results.

No Compensation for Unavoidable Interruptions

The straight piece system takes no account of factors and conditions of work which lie beyond control of the worker, such as breakdowns in machinery, lack of orders, defective

materials, etc. Under the time system such stoppages have no effect on the pay envelope, but under the piece system they mean an immediate reduction of earnings through no fault of the worker.

Under the straight piece system it is of utmost importance for the management to insure uniform conditions of production, suitable materials in steady supply, a constant flow of work, proper inspection and upkeep of machines, etc. The interruption of work by causes beyond the control of the employee obviously penalizes him unfairly.

Less than one-fifth of the reporting plants using the straight piece system replied that no special provision is made for lost time due to causes outside the control of the worker. Nearly three-fifths of the plants go part way and put the worker on time rates "when piece work is not available." Only a few make special allowances for any time lost through no fault of the operator. Characteristic replies may be quoted:

"When a machine breaks down we either change the employee to another piece work operation or, as we say, 'Ring him in on a day work card' which is O. K.'d by his foreman."

"Have employee ring out from piece work to day work time card on an expense operation."

"Provision is made in case of breakdown of machinery whereby a special allowance is made to the employee."

"We have been forced to keep an organization on a certain line of work through a slack period; in order to do this we had to pay a guaranteed weekly wage. We make up for no other losses."

"We do not attempt to make it up to him. Our machinery doesn't break down and if there's no work to be done there are no earnings for the worker nor profits for the employer."

"This is a matter we make no provision for as the average worker prefers to take his (or her) chance with piece work as it comes."

"When there is nothing to do men ring out."

Possible Adverse Effect on Quality of Product

In general, quantity and quality are supposed to be mutually antagonistic elements. Factors that increase the one tend to diminish the other. In so far as all incentive systems have for their objective the increase in quantity of output, it might be expected that quality will be adversely affected.

So far as such a tendency may exist, it can not be related

to this or that particular system, but rather to incentive systems in general, and depends upon the type of product and whether or not quality can be adequately controlled. With the risk of losing his additional premium through rejection of unsatisfactory pieces, the worker often has an incentive not only to increase output but to maintain quality as well. Experience upon this point is quite diverse, not only in the evidence offered in connection with the straight piece rate system, but in the replies of manufacturers who are using other incentive systems as well.

The tendency of piece work toward deterioration of quality of the product, as shown by the replies of manufacturers, depends upon the character of the particular product and the degree to which "quality" is important or easily influenced by the worker. The majority of manufacturers stated that the piece system had had no effect whatever upon the quality of the product or had even improved it, but some of these add such explanatory facts as, "because the quality is already insured by close inspection," or "because the worker is paid for good pieces only." "Rigid inspection only guarantees quality," writes one manufacturer. A very different point is offered, however, by the following comment:

"It has given us a better quality of work, *due to attracting a high grade of workman.*"

Another manufacturer says:

"Better pay better men who do better work. Imperfections are not likely when workers have their minds on the job. Damages are the results of carelessness and lack of attention. Idlers are the dangerous ones. Inspection must be thorough in any system."

The following testimony bears further upon the various aspects of quality under the piece wage system:

""The work must pass a high standard of inspection. We do not feel that the quality of work has been reduced by this system."

"Same quality of work with more production."

"Tends to hurt quality."

"Had a tendency to reduce quality, making very much more rigid inspection necessary."

"Has some tendency to produce inferior work but our rigid inspection checks this tendency."

"In starting the system difficulty will be experienced by getting poor work but this gradually drops out and is not troublesome."

"Better if anything. Good work always requires good supervision and inspection. Better work and better application go hand in hand."

"The quality of the work has not decreased through the introduction of the system, in fact, our standard of quality has been raised in the last few years far above that which existed under day work."

"Quality of work has improved through the interest of the men in their increased earnings. We have experienced better spirit in our organization and, therefore, better cooperation which reacts on the quality of the work."

"The system has not hurt the quality of the work. In fact in some cases the quality has been improved."

"The quality of the work may be adjusted to any degree required by the Engineering and Inspection Departments."

"The quality of work has been considerably improved."

"Benefited quality because of standardized conditions, operations and methods."

"We have had no defective work which could be directly attributed to the system."

Does Not Recognize Intangible Qualities of Workmanship

Finally, the piece work system is inelastic in that it fails to recognize such invaluable qualities as loyalty to the company, long service, care of equipment, versatility and general usefulness in the plant—qualities which play a considerable part in determining a man's value to his employer. "We classify jobs, not men," writes one employer. The rate for the given task is the same regardless of the operator.

The exclusion of any "personal" element in the wage payment, it appears, is a universal characteristic of the straight piece system, although in a few instances a broad distinction may be drawn, as on the basis of sex or color. The danger of jealousy and dissatisfaction among the workers evidently precludes discrimination. If any reward for these more or less intangible values is offered, it must be kept quite distinct from the production wage.

Combatting Disadvantages

The disadvantages of the piece wage system are far from proving insuperable obstacles to its adoption. Counteracting forces can be brought into play which are often successful in minimizing the drawbacks of the system. Various devices

have been employed to this end, some of the more important of which may be considered here.

Rate Guarantee or Revision

About two-fifths of the plants have adopted a policy of guaranteeing the worker against any change in his piece rates. This policy, while protecting the worker, merely shifts the entire risk upon the shoulders of the manufacturer—a risk which has in some instances at least, proved too great. One manufacturer comments:

"Rates were at one time guaranteed, except for changes in tools or methods, but with the advent of violent changes in labor rates, due to war and post-war conditions, guarantees were abandoned."

One plant has met the difficulty by guaranteeing the rates for the calendar year. Most companies, however, retain the principle of freedom to change rates even though they actually follow the policy of fixed rates. The practices of some concerns are described as follows:

"Piece rates are not guaranteed, but it is the policy to change them only in exceptional cases."

"No formal guarantee. It is rather an unwritten law not to cut until the season is over."

"We work upon the fixed principle that a piece rate once thoroughly established should not be changed downward."

"It is not necessary to guarantee rates except where rate cutting has been a habit. When we first installed piece work we did guarantee rates so that we would get speed."

In many establishments the workmen themselves are consulted about changes in rates. One-third of the reporting plants stated that the workers are allowed to pass upon the fairness of the rates. A somewhat smaller proportion of plants, while not formally consulting the workers, invite their criticism. Of the 84 plants answering the question, 28 stated that workers were consulted and allowed to pass upon the fairness of the rates; 32 stated that workers were not consulted, and 24 replied that, although not consulted, workers could at any time complain of a rate and secure a re-analysis and retiming. "If a worker does not feel that the pay allowed is satisfactory," one manager writes, "he has the right

to ask to be 'shown.' Then he is satisfied. If a mistake is made it is rectified." Other comments were:

> "When a piece rate is set the workers are consulted and it is given a fair trial to see whether it is fair to both employers and employees."
>
> "If for any reason the rate proves to be erroneous, due consideration is given and proper adjustment made."
>
> "All rate setting is open and above board and is agreed to by both parties."
>
> "Workman is not consulted before putting piece price into effect. The job is carefully analyzed before a price is arrived at so nothing would be gained by consulting him. However, if a man fails to make the base rate on his job an investigator is sent to determine what the trouble is."
>
> "We are always open to suggestions and advice of the workers, and any inequality or injustice they can clearly establish we try to adjust."

This principle of mutual consultation may, in the opinion of some, be carried too far. Thus, one employer warns: "Above everything else, avoid bargaining with the men." Even if the worker is consulted, the burden of proof remains upon the manufacturer to show that without hardship to the worker an output is possible sufficiently high to make earnings equal to, or even above, those prevailing or obtained hitherto for the work under the time wage system.

In short, the best way to avoid the contingency of rate cutting on the one hand and opposition to low rates on the other is to establish definitely, before introducing the piece system or any new piece rate, what output should reasonably be expected from the worker. The more accurately this can be determined, of course, the less danger there will be of applying an unduly high piece rate or of leaving room for questions on the part of the worker. Estimates made by the foreman on the basis of his past experience, or estimates based on plant records of past performance, are obviously more liable to error than carefully timed studies of the work done by an operative of known efficiency under regulated conditions. Some companies go so far as to maintain that past experience and foremen's judgments are almost worthless as guides.

Time Study

"Time study" has been particularly developed in connection with the more elaborate incentive systems, but since it is

essentially only a means for obtaining greater accuracy in measuring output capacity, it is not to be considered as an exclusive feature of any single system, or even of incentive systems as a group. The closer control by management over work performed, the opportunity offered for developing new economies in processes, and similar advantages resulting from time study may well be profitable under any wage system, including the original time wage.

"Time studies," in short, may be considered as synonymous with "accuracy." Under a given system accuracy may be more essential than under another, but time study as a feature of any system is to be clearly distinguished from the structure of the system itself. Thus, time study is a vital element in Taylor's Differential Piece Rate System, to be discussed in the next chapter, in the Emerson System and others, but it should be kept clearly distinct from the basic principle of these plans themselves, and not identified with them.

In the measurement or estimation of the output of his workers, each manufacturer must judge for himself the degree of accuracy advisable or practicable in his plant. For companies manufacturing a variety of products and handling comparatively small orders, general estimates based upon past experience may alone be possible, since the cost of making detailed studies may exceed the economies to be expected from them. Not only must the cost be reckoned with, but the possibility of error in setting many rates for a variety of products and processes, with the consequent necessity of cutting rates, must be duly considered in determining the choice of a system.

Among eighty-seven plants which furnished information as to how piece rates were determined, twenty-two set their rates by the estimate of the foreman or rate setter; fifty-five from analysis of the standardized operation, including time study; eight by combining both of these methods; one by arbitration; and one used the union schedule.

The use of the stop watch for obtaining the time required for the performance of a given operation has at times met with considerable opposition. Organized labor has in the past branded time study as humiliating for the operator

whose performance is measured with such mechanical precision.

To ascertain the attitude of workers toward time studies, manufacturers were asked what, if any, objections had been raised by workers to having time studies made on their jobs. Among the seventy-five straight piece work plants answering this question, objections were reported in fifty-nine cases, while in eight the reply was that objections had been made at first, implying that they had since ceased. One plant reported that workers claimed that time study made them nervous; seven plants never made time studies in the sense of using a stop watch. Among ninety-six plants using other incentive systems, no objections had been made to time studies in seventy-six cases; five had encountered objections, but only at first; in two plants objections were made by "a few old timers"; workers in two plants "don't like it," but apparently accept it; in two plants workers claimed that it made them nervous, and in one that it hurt their pride. In two plants time studies were made without the knowledge of the worker, and in six plants no time studies were made. Some of the replies received show how the question is handled, and the attitude of both management and workers:

"As the same objections can be raised to any method of determining what a fair amount of work is, a time study can be demonstrated to be fair. That is all a reasonable employee wants."

"Where time studies are taken by a careful man who understands the job and also human nature, no trouble is experienced."

"The timid workers complain that the taking of time studies on their jobs causes them to become nervous. We believe that time studies should be taken as much as possible without the operator's knowledge."

"No objection when workers are convinced that it is 'on the level' (which it should be)."

"We do not ask them. They naturally want to keep you in the dark."

"No particular objections but they do not take kindly to it. Better to control piece work prices in some other manner and not antagonize the worker."

"It is absolutely necessary for the operator to understand what is being done and why, before proceeding."

"This is entirely a matter of policy of the company and the personality of the time study men. In our plants we have not encountered difficulty because it is an old established practice."

"They do not object to time studies but do object if any rate is attempted without them."

"One or two claimed it made them nervous but the majority were glad to have it done as it meant a fair rate."

"Time studies were never made in such a manner that the workmen knew they were being timed."

"Some workmen are apt to be embarrassed by having time studies made of their work while others are inclined to be provoked, feeling that time studies are being applied to them because their production is not satisfactory. Others ask for time studies on work not covered by the premium system. We find this very largely a matter of the human element."

"We experienced no difficulty in timing the jobs. Some of the workers may tend to 'stall' while they are being studied but an experienced observer will soon detect it."

"There have been no objections on the part of the operators to time-study work after the first day's premium was earned under the new system.

"Few objections are raised as all time studies are taken in the open and usually on an average worker. Objections have arisen where a pace setter was used in making the study, but by giving consideration to the individual's productive ability when determining the rate, these objections are eliminated."

"Not any, unless it is to object because time study is not taken quick enough so that premiums can be placed on the job."

"Time studies have been made in this plant for so long a time that they are thoroughly acceptable as routine. Naturally, however, no man is going to unduly exert himself under the watch."

"Our people are desirous of having their jobs timed out as soon as possible in order that they may earn premium."

"One group of fifteen or twenty workers refused at first to permit time studies and struck; they returned in three days and gave no more trouble. No other serious opposition was noted."

"No more than the usual amount of complaint."

"We make absolutely no time studies on the job such as holding a stop watch on an operator or anything of this kind as we find them worthless. Even if the operator attempts to give you good work while you are studying the operation, the actual machine time on running one or two pieces is practically no guide on the time taken to machine 100 or 1,000."

"None, after the purpose and methods are explained. There must be an expectation of fair play and considerate treatment."

"Many objected to having their work time-studied. Had the idea the management was attempting to drive them to do more work for less money. Objections occurred where certain workmen have been shirking their duty and curtailing output."

"All sorts of objections—all overcome by not insisting on making the studies. No studies, no bonus, and they all soon want the bonus."

"Reports on time study show that plants which explain it to the men and do it on the level, incur no objections. 'Stop watch in the pocket' causes trouble."

That such measures, designed to obviate the need of rate changes, have not yet been universally applied in conjunction with the piece system, and that even where used they have not fully succeeded in their objective, is clear from the replies to the questionnaire. Almost half of the plants using the straight piece system stated that they had at one time or another found it necessary to reduce rates. A few of the comments regarding this policy are of interest:

"We revise piecework prices annually in accordance with commercial conditions."

"Rates are constantly being adjusted both upward and downward, to meet the changing conditions in the labor market, changes in methods or tools, or to correct previous miscalculations in rate fixing."

"We have an understanding with the men where the price on a job is high, that a reduction will be made, and where found to be low, an increase will be made."

"In many cases the workmen will agree that reduction be made."

"If earnings are too high on a specific operation because the average production is figured incorrectly, rate is allowed to stand."

The Attitude of Labor toward the Piece Wage System

The attitude of the workers in a plant toward the piece system, or toward any system of wage payment in which compensation is directly related to quantity or output, is not always the same when the system is being installed or is in contemplation as it is after such systems are put in operation. The danger of rate cutting, the possibility of the worker finding himself driven too hard or of being discovered inefficient, the mere annoyance of a change from the customary, arouse opposition to the introduction of an incentive system. The less violent the change from one system to another, therefore, the less serious will be the opposition experienced. Tact is most essential. A few of the replies on this point are significant:

"Opposition was made only by the inefficient."

"Feared reduced earning power, or that they would be obliged to work harder to earn same amount."

"Considerable. Nearly all workers claim that prices are low and that wages cannot be made."

"Many of our older employees opposed piecework on the basis that they were producing all they could then. But the younger and newer employees enthused over piece rates and when they were installed, increased their own earning power and at the same time, that of the slower and older workers."

"Very little. It is advisable to concentrate on a small group of men or department, being sure that the price is correct. Results spread and the rest is easy."

"Piecework can be applied in any factory if the management will go into the matter in a slow consistent way, gaining the workers' confidence, selling the idea—not thrusting it down their throats. They must understand every part of the idea as to what economies the company will obtain as well as what they, individually, will receive."

Once the system has been established, however, the attitude of the worker is reversed; he opposes a return to the time system. The opportunity offered for advancing themselves by their own efforts is highly valued, if one may judge from such comments as the following:

"Within present recollection, no opposition on the part of workers who are willing to deliver 'a fair day's work for a fair day's pay.' No consideration given to the other class."

"The men would not work willingly under any other system."

CHAPTER III

EARLY SPECIALIZED INCENTIVE SYSTEMS

THE growth in size of industrial enterprises in the United States, which has extended the field for incentive systems and made them increasingly advantageous, has aroused interest in various modifications of the piece wage system which have been contrived to obviate its difficulties and disadvantages, while retaining its incentive feature.

General Characteristics

The fundamental characteristic of the piece wage system is uniformity in the basic rate but diversity in time earnings. A modified piece rate with guaranteed time wages partakes of the nature of both systems, offering for the lower grade operators uniform time earnings and for those of higher capacity diversified time earnings.

The more complicated incentive systems usually have the same results as the guaranteed piece wage, so far as the earnings of the operators are concerned, although the method of measuring the earnings of the superior workers may differ. One exception to this statement, to be considered in detail later, is the Taylor differential piece wage, which is essentially a modification of the straight piece wage system.

The essence of all of these systems is the treatment accorded to the workers who reach or surpass a certain level of efficiency as related to an assumed normal or standard performance. All of the systems insure to these workers higher earnings than does the time wage system. The method by which it is accomplished varies. Sometimes it is by a definitely fixed higher and uniform piece rate (Taylor) sometimes it is by a time measurement which is the equivalent of a definite piece rate (Gantt), and again by time measurements which are equivalent to differential piece rates (Halsey).

Whether the time wage expression is preserved or discarded, the general effect of all the systems to be considered

is usually an increase of production over the time wage system. Like the straight piece wage they bring about reduced labor costs to the manufacturer, and increased earnings to the superior workers. But, unlike the straight piece wage system, the specific wage systems to be considered, with the exception of the Taylor system, usually involve no loss of earnings for workers who produce less than the normal or standard output upon which the system is based.

The Halsey System

Because it does not require careful time studies, the Halsey system may well receive first consideration. In 1891, Mr. F. A. Halsey, who was one of the earliest forerunners of the modern efficiency movement, installed in the factory of the Canadian Rand Drill Company a plan of wage payment whereby the worker, while receiving his regular time wage, was offered in addition a premium for increased production over a stated normal day's work. This premium was expressed as a percentage of his time rate applied to the time he was able to save. The Halsey Premium Plan thus involves no attempt to measure accurately possible production but adopts present output as a basis.

The Wage Premium

Assuming present output to be a fair average, the Halsey plan offers to share with the worker the saving accomplished by doing the job in less time. For each job a time limit or standard is set, within which there should be no difficulty in performing the work. The employer guarantees that the time limit will not be changed unless there is some fundamental change in the method of manufacture; he guarantees, also, that even if the standard performance is not attained, the operator will receive his full hourly rate. If the job is performed in less than the time set, a premium of a certain per cent of the time saved is paid in addition to the regular hourly rate for the time consumed. The per cent of premium to be paid varies according to the requirements of the job or the policy of the company, but the Halsey Plan has usually called for the payment of between 30% and 50%

premium. The important point is to offer a premium high enough to stimulate genuine effort on the part of the worker.

There are obviously two methods of applying the premium system. The time limits may be set strictly and made difficult of accomplishment, with a substantial premium for bettering the standard; or time limits may be lenient and the premium for time saved be small. The latter method was advocated by Mr. Halsey, but in recent years the tendency has been in the opposite direction.

The chief advantage of the Halsey scheme is the retention of the ordinary time wage. Adoption of the plan involves no disturbing changes or obscurities, no question as to rates, and every worker above normal efficiency has an opportunity to earn a bonus according to his ability.

Simplicity of System

In fact, probably none of the newer systems can be introduced with less disturbance to existing conditions than the Halsey premium plan. It calls for no violent readjustment or change to an entirely new wage base. The worker is assured of at least the amount he has formerly earned, since his hourly rate remains unchanged. The only difference introduced by the premium plan is the possibility of earning an additional amount by the better direction of his energies. In other words, without in any way prejudicing his present earnings he is given the opportunity to increase them. Then too, because of the simplicity of the system, workmen could calculate the premiums for themselves and thus be assured of all that was coming to them.

Furthermore, since no exhaustive analysis of operations is required, the plan can be put into effect almost at once. The Halsey premium plan is not predicated upon standardized operations, and therein lies its appeal to the manufacturer who hesitates to assume the expense of an intensive analysis of operations. It accepts conditions as they are, and time limits are set on the basis of the average daily performance.

In effect, this system results in increasing time earnings for higher efficiency, but diminishing the piece rate or labor cost per unit. It embodies the incentive feature, which interests the worker, and at the same time gives the manufacturer the advantage of a lower unit labor cost.

Tabular Presentation

In Table 10 the methods of the Halsey system are applied to the hypothetical case represented by Table 9 on page 16.

TABLE 10: OPERATION OF THE HALSEY SYSTEM

(Source: National Industrial Conference Board)

Normal time rate—$10.
Normal output—0.50 pieces.[1]
Wage = time taken × time wage rate plus premium.
Premium = 50% of time wage rate × time "saved" over normal.

Efficiency Grade	*a* Time Taken per Piece	*b* Units of Time Saved per Piece	*c* Premium on Time Saved per Piece	*d* Wage on Time Taken per Piece	*e* Wage Plus Premium per Piece	Wage per Unit of Time	*f* Total Labor Cost per Unit of Time
A	0.667	1.333	$6.66	$6.67	$13.33	$20.00	$20.00
B	0.714	1.286	6.43	7.14	13.57	19.00	19.00
C	0.769	1.231	6.15	7.69	13.84	18.00	36.00
D	0.833	1.167	5.83	8.33	14.16	17.00	85.00
E	0.909	1.091	5.45	9.09	14.54	16.00	160.00
F	1.000	1.000	5.00	10.00	15.00	15.00	300.00
G	1.111	0.889	4.44	11.11	15.55	14.00	350.00
H	1.250	0.750	3.75	12.50	16.25	13.00	260.00
I	1.429	0.571	2.86	14.28	17.14	12.00	120.00
J	1.667	0.333	1.66	16.67	18.33	11.00	44.00
K	2.000	..	..	$20.00	$20.00	$10.00	$20.00

Total labor cost..... $1,414.00
Cost per piece..... $15.47

[1] See discussion of normal output on p. 16 of this volume.

Column *a* in this table, "time taken per piece," corresponds to the column in Table 9, "time per unit of product." In order to illustrate the workings of the system the group K, which produces at the lowest rate, one unit of work in two units of time, is taken as a basis for computing the remuneration of other groups. As has already been stated in general terms, this remuneration depends upon the time "taken" and the time "saved." The worker A, as before, produces 1½ units of work in a unit of time. In other words, he requires or "takes" only .667 units of time for a unit of work (col. *a*). For the time taken he is paid at the regular rate of $10 per unit or $6.67 (col. *d*). In addition, he receives a premium on the time saved, which for him is 1.333 units of time (col. *b*), the difference between the base time, 2 units, and the time "taken," .667 units. If this saved time were

paid for at the normal time rate, it would require $13.30. But under the assumption in this case, only half of this sum is paid as a premium and this amount, $6.66, is recorded in column *c*. For every unit produced under this plan, A receives a wage of $6.67 plus a premium of $6.66 or $13.33 (col. *e*). This constitutes the manufacturer's labor cost per unit of work. Since the worker, however, has gained this sum in two-thirds of one time unit, his earnings for a full time unit will be one and a half times $13.33, or $20 (col. *f*). For the worker in group B, the time taken (col. *a*) is somewhat greater, the time saved (col. *b*) somewhat less. The premium (col *c*), one-half the time saved multiplied by the time wage, is therefore less. However, because more time was taken to do the work, the manufacturer's cost per unit of work (col. *d*) is greater. So also are the worker's earnings per unit of work. Since, however, he has taken a longer time to produce each unit of work his earnings per unit of time $19 (col. *f*), are less than those of the more efficient worker A. These relations will be observed throughout the table. As the time taken per piece (col. *a*) increases, so will the direct wage payment per piece (col. *d*). Conversely, the time saved will decrease (col. *b*) and with it the amount of the premium (col. *c*). Since, however, the time taken is paid at a higher rate than is allowed as a premium, the earnings of the workers for each unit of work and the labor cost of the manufacturer for each unit of work (col. *e*) increase as the time taken increases. For each unit of work, the higher the premium the lower the cost, and the lower the premium the greater the cost. Translated into terms of time (col. *f*) the converse is the case; the higher the premium the greater the earnings in a given time, the less the premiums, the smaller the earnings.

So much for the rates paid to each group of workers. To ascertain the labor cost for the output of each group and of the entire force, the wage per unit of time (col. *f*) must be multiplied by the number of workers receiving each rate of pay (col. *e* of Table 9). It is obvious that an equally valid method of finding the wage cost per output would be to multiply the rate per unit of work in each group (col. *e*) by the total output of each group (col. *f* of Table 9). The results noted in column *g* of Table 10 show that the total labor cost

of producing the entire output of 91.4 units is $1,414 or $15.47 per unit of work. This is less by 23% than the labor cost under a straight piece wage system at the rate of $20 a piece.

Assuming that this rate of $20 a piece corresponds to conditions of production actually prevalent, this 23% difference is the manufacturer's advantage in reduced labor costs per unit. It is clear that as the rate of premium is varied, this advantage will be greater or less. The proportion which appears to be most generally used for the premium rate is 50%, but some of the plants covered by the Conference Board's inquiry offer the worker less than 25% premium while a few pay as high as 75%. One establishment gives two rates—33⅓% on machine work, and 50% on bench work; another pays 20% to 50% according to the desirability or difficulty of the work.

While the amount of the premium is one of the variable elements in the application of the system, it is not the only one. Another variable is the composition of the working force. With a given "normal" production and a given premium rate, considerable economies for the manufacturer will result in so far as he is able to pick his labor force among workers of the higher grades. Quite as important is the determination of the "normal" product.

It is to be borne in mind that the figures in the foregoing table are designed to indicate the nature of the differences between this and other systems rather than to measure their amount, since any change in the conditions of the basic situation would vary the latter. In the illustration it was assumed that the least efficient workers employed fixed the rate of normal production under the time wage system. But in the discussion of piece wages it was shown that these workers are probably not to be considered as the ordinary workers who under time wages set the pace and determine the volume of production.

If, then, the normal used a basis for the Halsey system were fixed at a higher point, the results might be quite different. Let it be assumed, for example, that the normal product is 0.7 units of work in a unit of time. The following results would ensue: the total labor cost per unit of time

would be $1,157.69, the cost per unit of work would be $12.66, and the average time wages would be $11.58. Under the time wage, the output would be 69.2 units produced at a cost of $1,000 or $14.45 for each unit. In this case the manufacturer's advantage on unit labor costs is measured by the comparison between $14.45 and $12.66, and amounts to a reduction of 12.32%.

It remains to consider briefly how the system under different conditions affects the earnings of operators. An examination of Table 10 shows that with a normal output of 0.5 units of work in one unit of time, average time wages increase from the normal rate of $10 to $14.14, and that with the exception of workers in class K, who still receive the former day rate, all workers share in some degree in this change. In fact, the worker A, with time earnings of $20, has his earnings doubled. With a normal of 0.7 units of work in one unit of time, the effects would be similar in kind but less in degree. Average time earnings would increase from $10 to $11.57. Sixteen workers in the three lower efficiency grades would find their wages unchanged, while eighty-four workers would have an increase. This increase would range from 67 cents for the workers of class H to $5.72 for the worker A.

Chief Criticisms

A criticism of the Halsey System which is frequently encountered is the absence of careful time studies to determine a normal day's work, and the ease, therefore, with which the employee can "soldier" while the rate is being set. But the lack of time studies in many instances is not an essential feature of the system itself. In the early stages of scientific management, time studies had not been developed but this is no reason for not applying them today if conditions justify the cost. The time study can be and is used today under the Halsey System. Thus one manufacturer states that "the cost of time study and clerical work is more than offset by reduced supervision."

A more pertinent criticism is the claim that the management retains a share of the worker's "true" earnings. Halsey's own justification of this feature was that increase in

production under the incentive system is accompanied by additional wear and tear of equipment, heavier overhead expenses, and like costs. Furthermore, in the absence of careful time studies, which may be too costly in some industries, it is important to have a margin to cover actual errors in establishing the "normal" output.

Experience of Plants under the Halsey System

All those plants using the Halsey system which replied to the questions of the Conference Board reported an increase both in their production and the employees' earnings, and a reduction of the cost per unit of product. The increase of production ranged from 10% to over 100%, the median[1] being 40%. The increase in earnings reported ranged from 10% to 45%. The median was 20%, but a third of the establishments reported a 10% increase. The reduction in wage cost per piece was given as anywhere from 5% to 55%, with the greater number reporting 20%, which was also the median.

It is uncertain how much reliance can be placed upon these figures. Many are obviously guesses. Yet they offer a general proof that production is considerably increased, that earnings are greater than under the time wage system, and that unit costs are reduced. The following statement shows how the system is regarded by some manufacturers:

> "The premium system offers additional economies over the straight piece-rate methods as has been very clearly demonstrated in our work here. The writer's personal views are that the premium system is far superior to almost any other method of supplying an incentive."

Like the piece wage system the Halsey system embodies incentive element. Except for a few instances, the plants reported that 70% to 100% of the employees under the system were able to earn a bonus. Over half of the replies included from 90% to 100% of the workers in this group.

Most important, the Halsey system appears to reach its objective in obviating the necessity of rate cutting. Almost

[1] The median is used throughout this report as the safer form of expression, because it avoids any distortion likely to occur in an arithmetical average of rates because of the presence of one or more wholly exceptional figures.

all plants reported that they have been able to avoid cutting rates, except as a result of changes in method or machinery used; only two or three have had to change the rates on account of "glaring mistakes" in the time allowed. The testimony on this point is uniformly favorable:

> "The system has the decided advantage of allowing us to set standard allowances that do not have to be changed unless a tool change or change in design is made."
>
> "The system was introduced in order to have the rates standard rather than to change piece work rates in inflated and deflated periods."
>
> "The system was introduced because of too much dissatisfaction with piece rates and suspicion of their being cut."
>
> "If a man makes too much money because a mistake has been made in setting time we try to get his consent to a reduction; if he does not give it, the rate stays."
>
> "In some cases we have found men to make exceptionally high earnings, but we have kept our word and have not changed the time limits as a result. We feel that the ability on the part of the man to make exceptional wages is a reflection on our own previous knowledge of what constituted a day's work and that no matter how high the men's wages are, our own costs are coming down in the same proportion."
>
> "The advantage of the Halsey system is that men are not so heavily penalized for delays beyond their control, and another advantage that men may be more readily transferred on jobs. A disadvantage is that men will soldier if there is little work. They prefer to drag out the day and make the day rate rather than catch up and be sent home. Piece workers would do the latter."

In general, there was little dissent from the opinion that the system is effective in promoting industrial harmony. The responsibility for low earnings is placed squarely on the shoulders of the worker, leaving no room for complaint of favoritism or neglect on the part of the management. After the system has once been established, the men demand its continuance, and employees still on the time basis ask for its extension to their own work. In only one instance did the manufacturer find the men persistently unreasonable: "A man rated at 55 cents per hour and earning $2,200 in one year still argues that he gets only 55 cents. Where opposition to the system on the part of the men was reported, it appears to have arisen chiefly from the inefficient workers, and at the beginning, from a suspicion of some unfair treatment and

perhaps a dislike of having their work observed and time studies taken. This appears clearly in the following statements from companies using the system:

> "Biggest opposition came from a suspicion by the workmen that standard time would be set too low and that experience might cause firm to make further reduction in standard time."
>
> "It was enthusiastically received."
>
> "None after being thoroughly explained to the men."
>
> "The only opposition encountered was a feeling on the part of some that they ought to receive all of the savings which they made . . . rather than only 50% which we were willing to give them. This was easily overcome by explaining to the men that any arrangement for increased earning must be of mutual advantage. . . . It was also explained to the men that by simply changing the standard time which we set we could easily make matters appear on the books as though they were receiving all the savings, whereas actually we were giving them what we wanted to. On the other hand, we preferred to play fair. . . ."
>
> "No open opposition was encountered although slight attempt at passive resistance was encountered due to a feeling by supervision that it was a system devised to show them inefficient."
>
> "Some opposition at first due chiefly to suspicion that the rate set would be cut."
>
> "When we started the system in 1909 it took much persuasion; the workmen did not understand it. The system was discontinued in 1918 when the Navy commandeered our Works. The workmen requested repeatedly reintroduction and it was started again in 1922."

Relation to Regular Time and Piece Rates

Since the time wage is used as the immediate basis for computing the premium, it would appear that the Halsey system not only corrects the inflexibility of the piece wage relative to current market wage rates, but also permits adjustment of compensation to personal qualifications of the individual, such as versatility, loyalty, and the like. One manufacturer says:

> "I believe this plan has greater possibilities of being generally applied than some others, because it is so flexible that it can be fitted up to meet almost any requirement."

In practice, however, it appears that even under the Halsey system as under the piece system, output is taken as the direct measure of wages for work of similar nature. This may be due to the fact that, under straight time pay, differences in output are minimized and covered up so that the

differences in length of service, etc., become relatively more noticeable as legitimate determinants of variations from the normal rate, while on the other hand, where differences in output are emphasized as the direct determinant of variations from normal, the other factors appear to fall into the background.

This applies generally to the modified bonus systems, to be discussed in the next chapter, which in a similar way measure their premium as a direct percentage of the time wage. With few exceptions, an individual wage rate, including special reward for personal qualities, does not appear to be used as a base. The time wage basis, as evidenced by replies to the questionnaire, is still a rate for the job and not for the man.

With respect to the other advantages and disadvantages ascribed to the piece system, the Halsey system appears neither better nor worse. It is applicable to standardized goods and unsuited to irregular production, as the following testimony indicates:

> "Our Halsey system was set with old piece rate in mind supplemented by time study. Those who are 75 per cent efficient or above save us money over the old piece rate. Several workers have reached 100 per cent efficiency."
>
> "Looking at it in the broadest sense, we do not believe that the size of the plant would have very much effect upon the system. We do not see why the system could not be used in a stool rolling mill or in a shirt and collar factory, in fact, anywhere where unit articles are manufactured."
>
> "It is applicable to any sized plant but believe it would be an expensive proposition for company operating under 150 employees. Also the plant must have a steady run of production day after day."
>
> "It is our opinion that if this system can be worked out in a plant of this kind doing special work where dozens of jobs will be estimated each day, also where we are working to a thousandth of an inch, that there should be little or no trouble in installing a system which would work out in any plant."

Supervision for quantity may be reduced, but inspection for quality must be maintained or increased. There is likely to be some increase in clerical overhead, unless at the same time measures of one sort or another be adopted to stimulate clerical output. About three-fourths of the plants using the Halsey system reported it to be "simple and inexpensive"; perhaps one-eighth remarked on the additional clerical work involved. Most of the remaining plants, after noting this expense, testified that "it pays." One manufacturer replied that he had adopted the plan because it "is simple to operate and easy for the men to understand," and because "it is not necessary to make an accurate time study of each job."

In contrast with these favorable comments, the following statement stands by itself in sharp relief:

> "We have discarded the premium system in all departments except one, and it is going just as soon as possible. We found that there was not enough incentive to get maximum production; that the average operator can not figure it and as a result is seldom satisfied with his pay . . . ; that it takes more clerks and the percentage of errors by payroll clerks is high and result is over or under pay which causes unrest among employees."

Rowan Variation of the Halsey Plan

The Rowan variation of the Halsey system seeks to protect the manufacturer from the necessity of paying excessive premiums resulting from some exceptionally "glaring error" in establishing the normal piece rate. On the ground that no incentive can stimulate the worker to increase his output over 50% of his ordinary fair product, and that any apparent increase in excess of this is due to too low a standard or to soldiering on the part of the worker, the reward is proportionally reduced for production beyond this point.

The method by which this is effected is, first, to use as the premium percentage, not a flat 50% or 30%, as under the Halsey system, but a variable percentage equal to the ratio of time saved to the normal time, or stated another way, the percentage of output above normal. For instance, if the worker saves a fifth of the time, or produces a fifth more than standard output, his premium rate is 20%. Second, instead of this percentage being applied to the hourly pay for time saved, it is applied to the pay for time actually taken. Thus, the less time an operator takes, the greater his percentage rate, but the smaller the principal sum to which it is applied.

Tabular Presentation

A comparison of the results under the Rowan plan with those under the Halsey system is afforded in Table 11, on the following page.

TABLE 11: OPERATION OF THE ROWAN SYSTEM

(Source: National Industrial Conference Board)

Normal time rate—$10.
Normal output—.50 pieces.
Wage = Time taken × normal rate plus premium.
Premium = Percentage of wage for time taken equal to percentage of "normal" time saved in actual operation.

Efficiency Grade	*a* Time Taken per Piece	*b* Time Saved per Piece	*c* Percentage of Normal Time Saved	*d* Premium per Piece	*e* Wage on Time Taken per Piece	*f* Total Wage Plus Premium per Piece	*g* Wage per Unit of Time	*h* Total Labor Cost per Unit of Time
A	0.667	1.333	66.67	$4.44	$6.67	$11.11	$16.67	$16.67
B	0.714	1.286	64.29	4.59	7.14	11.73	16.43	16.43
C	0.769	1.231	61.54	4.73	7.69	12.42	16.15	32.31
D	0.833	1.167	58.33	4.86	8.33	13.19	15.83	79.17
E	0.909	1.091	54.55	4.96	9.09	14.05	15.46	154.55
F	1.000	1.000	50.00	5.00	10.00	15.00	15.00	300.00
G	1.111	.889	44.44	4.94	11.11	16.05	14.44	361.10
H	1.250	.750	37.50	4.69	12.50	17.19	13.75	275.00
I	1.429	.571	28.57	4.08	14.29	18.37	12.86	128.57
J	1.667	.333	16.67	2.78	16.66	19.44	11.67	46.67
K	2.000	..	..	..	$20.00	$20.00	$10.00	$20.00

Total labor cost..... $1,430.46
Average cost per piece..... $15.65

In this table the time taken (col. *a*) and the time saved per piece (col. *b*) are, according to the condition of the problem, the same as in Table 10. So, too, is the wage payment for the time taken (col. *e*). The difference between this table and that which precedes it lies in the calculation of the premium. Under the Rowan plan, the first step is to figure the percentage of the normal time saved, which is done in column *c*. To obtain the premium, this percentage is applied to the wages on time taken (col. *e*) and the result appears in column *d*. If the results for worker A be again followed, it will be seen that in saving 1.333 units of a normal time unit (col. *b*), he is saving 66.67% of this time (col. *c*). He receives for the time taken $66.7; his premium is 66.67% of this amount, or $4.44 (col. *d*). His total wage for one unit of work is $11.11, and since he does 1.5 units of work in a single unit of time, for one unit of time he receives $16.67 (col. *g*). The operator in grade B takes a longer time for each unit and receives more wages for the time taken. He saves less time,

and hence his premium rate is a smaller percentage of normal time. But this smaller percentage applied to the longer time taken per unit gives him a somewhat larger premium on each unit. By reason of larger payments both of time wages and of premiums, his return for each unit of work completed and therefore the wage cost to the manufacturer are greater (col. *f*). But since he accomplishes less in a given unit of time, his time earnings are less (col. *g*) than those of the more proficient worker A. As efficiency decreases, the percentage of time saved (col. *c*) decreases with it. However, as may be seen from Table 11, the amount of the premium per unit of work rises from class A to class F, and after that point declines until it reaches zero in class K (col. *d*). On the other hand, the combined wage and premium payment (col. *f*), or the manufacturer's labor cost for each unit of work, increases regularly with each decrease in the efficiency of the workers. In similar manner the time earnings of the workers diminish as their efficiency grows less (col. *g*). The labor cost to the employer (col. *h*) can again be determined by the simple method of multiplying the time wage rate for each group (col. *g*) by the number of workers in the group (col. *e* of Table 9). The total labor cost appears as $1,430.46; the average earnings as $14.30, and the average cost to the employer for each unit of work produced as $15.65.

These results should be compared with the Halsey system, of which this is a modification. Premiums per unit of work under the Halsey system increase regularly with the efficiency of the worker. In the upper grades of efficiency they are higher under the Halsey system, while in the lower grades they are much higher under the Rowan system. Likewise, the labor cost per unit of work is considerably higher under the Halsey system in the upper grades of efficiency as are also the time earnings of employees. In the lower grades of efficiency the Rowan system is more favorable to the worker and gives him a greater incentive. Average earnings of workers and the average labor cost to employers are slightly less under the Halsey than under the Rowan system. Hence the reduction of the manufacturer's direct labor cost per unit, figured under the Halsey system as 23%, becomes under the Rowan system 22%.

As under the Halsey system, premiums under the Rowan system are based upon actual production of the "normal" worker. If there is some latitude in determining what is the output of the normal worker, there will be variation in the results with a given distribution of efficiency grades and of workers within those grades. It was seen in the discussion of the Halsey system that the "normal" worker might plausibly be deemed one somewhat higher in efficiency than the lowest grade worker actually employed. To illustrate this point, results were worked out on the assumption that the normal worker was one whose output was 0.7 units of work to one unit of time. Applying the same basis to the Rowan system, total labor costs for the production of 91.4 units become $1,214.64 and the average labor cost per piece becomes $13.27. These results would represent to the manufacturer considerable advantage in unit costs over corresponding costs under the time wage system, but the advantage would be somewhat less than under the Halsey system.

Considering the effect of the system upon the earnings of the workers, it will be seen from Table 11 that average earnings increase from $10 to $14.30 per unit of time. Workers in class K receive the same amount as before, but all others receive more. In the case of the highest worker the increase is equal to two-thirds of his former wage; in other cases it is less in proportion to the workers' efficiency. When the normal output is assumed to be 0.7 instead of 0.5 units of work as in Table 11, the reduction in total labor costs as compared with Table 11 entails lower earnings, which would average $12.14. The increase for the highest grade worker would be $5.34, with diminishing increases as efficiency decreases. Class I and below, representing 16% of the workers, would receive the same as under the time wage.

Experience with the Rowan Plan

Few establishments in the United States operate under the Rowan system. It was devised and applied in England when modifications of the piece system were first being attempted, and experiments under the Halsey system were meeting with disaster owing to the establishment of faulty normal standards of production. Progress in the accurate measurement

of productive efficiency has so greatly reduced the danger from this source—as evidenced by replies to the questionnaire from concerns under the Halsey system—that the need for such protection has been almost entirely removed. Moreover, the system protects only from extreme errors. Moderate mistakes may still require changes.

The Rowan plan has the added objection of the apparent unreasonableness of penalizing highest efficiency. It is open to greater suspicion on the part of the workers on account of the variable percentage, and owing to the same feature it involves slightly more clerical expense in its application.

The Taylor "Differential Piece Rate" and the Merrick Modification

Several years before Halsey developed his premium system based upon the time wage, Frederick W. Taylor had developed his modification of the piece wage system along an entirely different line. The essence of his plan was to set two rates, one well above the converted or normal market time rate, and one somewhat below, and to limit the workers who should receive the high rate to those who were able to reach and surpass a specified standard of performance. This standard was not, of course, as in the Halsey system, based upon the work usually accomplished by the ordinary worker considered as "normal," but on a higher level of attainment. The effort was to establish a standard attainable by proficient operators working under the best conditions.

Determining the Standard

The crucial point of this system is the ascertainment of the standard above which the higher, below which the lower piece rates prevail. To ascertain this standard, Taylor introduced his accurate time studies. Since most of the troubles with piece work had grown out of careless rate setting, it was safe to assume that if rates could be set accurately, piece work could be made to secure increased production and to reward the worker in proportion to his output.

Every operation was carefully analyzed, broken down into standardized elementary functions, and timed with a stop

watch by experts. Suitable equipment was supplied to the workers to obtain the highest degree of efficiency. The stoker, for instance, after careful study of his job, was supplied with one kind of shovel, the man digging sand, with another kind, and the man shoveling cinders, with still another. With the appropriate tool in the worker's hand, the amount of work for a given unit of time was ascertained. Finally, standards for complete jobs were reached by totaling the standards for the elementary operations of which it is composed.

Tabular Presentation

Apart from the fixing of the standard above described, the application of the system, shown in the following Table 12, is of great simplicity.

TABLE 12: OPERATION OF THE TAYLOR SYSTEM

(Source: National Industrial Conference Board)

Normal time rate—$10.
Standard output—1 piece.
Taylor piece rate—standard and over $15.
Taylor piece rate—under standard $13.

Efficiency Grade	*a* Output per Unit of Time	*b* Wage per Piece	*c* Wage per Unit of Time	*d* Total Labor Cost per Unit of Time
A	1.50	$15.00	$22.50	$ 22.50
B	1.40	15.00	21.00	21.00
C	1.30	15.00	19.50	39.00
D	1.20	15.00	18.00	90.00
E	1.10	15.00	16.50	165.00
F	1.00	15.00	15.00	300.00
G	0.90	13.00	11.70	292.50
H	0.80	13.00	10.40	208.00
I	0.70	13.00	9.10	91.00
J	0.60	13.00	7.80	31.20
K	0.50	13.00	6.50	13.00

Total labor cost..... $1,273.20
Average labor cost per piece..... $13.93

Here, again, the workers are assumed to have the same varying degrees of efficiency as in Table 9, and the first element in fixing earnings and wage costs is the output per unit of time (col. *a*). This output is remunerated in class F and above at the rate of $15 per piece, and in classes of lower

efficiency at the rate of $13 per piece. So far as the mathematics of the payroll is concerned, workers on a given occupation are on two piece rates instead of one. In each group the time remuneration varies by one factor only, namely the quantity of the output, and is easily calculated from the assumed piece rates and the given output for each class (col. *c*). Referring to Table 9, either for the output of each group or for the number in each group, the total wage cost (col. *d*) can be computed on the basis of the piece wage or the time wage. With the assumed piece wages the total wage cost appears as $1,273.20, and the average cost per piece as $13.93.

Rigorous Standards Eliminate Poorer Workers

Under Taylor's own application of the plan, the differential scheme was considered principally as a means to eliminate entirely from the shop all workers below standard. The purpose was to make it worth while for the thoroughly competent men to do their best, and to discourage men not so well qualified, who, if habitually unable to accomplish standard performance, would eventually drop out and seek work for which they were better qualified. "The employers can well afford to pay higher wages per piece even permanently," he said, "providing each man and machine in the establishment turns out a proportionately larger amount of work."

This may have been true in the particular industry in which Taylor first conceived his plan, where the plant equipment consisted of expensive machinery, such that increased economy in operation was in itself sufficient to cover the cost of the higher piece rates, or where the profit per unit may have been exceptionally high. If this practice were adopted in every industry, however, the result would be simply an exaggeration of the difficulties of the straight piece system.

The plan provides the valuable incentive feature of the piece wage system for the entire force from the least efficient to most efficient worker. The fact that the poorer worker receives a lower piece rate does not remove the incentive to increase production according to ability, as one might be led to believe from the writings of some critics. For a worker to curtail his output because he could not quite attain the

standard of efficiency would be to reduce his earnings still further.

Criticism of Plan

Nevertheless, the abrupt change from the low to the high rate has often been criticized. Without doubt, the discouragement attending failure by a narrow margin to reach standard performance is a serious consideration. It may be met, perhaps, by lowering the standard of 100% efficiency, and thus making it more easily attainable; but this, it must be remembered, automatically reduces the manufacturer's advantage, and must be accompanied by a reduction of one or both of the piece rates.

The question of the psychological reaction of the workers under the system hinges upon the question of whether a man will be willing to accept less than prevailing wages for the possibility of a great though somewhat distant reward. The answer resolves itself into a study of the particular group of men under consideration. If they are naturally far-sighted and ambitious, they will respond effectively to the distant prize.

Experience with the Taylor System

Too much importance must not be attached to the reported percentage gains in production under the Taylor systems in operation, for, aside from the question of their accuracy, they would naturally vary in each establishment according to the type of work, the policy of the management, the calibre and energy of the operators, etc. However, for what they may be worth, the figures reported for the Taylor system may be compared with the corresponding figures for the Halsey and piece systems. In reply to the Conference Board questionnaire, plants using the Differential Piece Rate System reported a resulting increase in production ranging from 10% to 80%, the median being 25%; increased earnings from 8% to 50%, the median being 20%; and decreased unit cost from 4% to 36%, with a median of 17%. The companies under the Halsey system reported increased production at a median of 40%, earnings at 23% and reduced unit costs at 20%. Under the straight piece system the

production was increased 30%, earnings 25%, and unit costs reduced 21%. In other words, the Taylor System appears to be less successful in eliciting full response from the worker. Nevertheless, the observation must not be omitted that, with only one exception, the plants under the Taylor system reported that there is no positive dissatisfaction against the system among the employees. That exception was in a plant where rates had been set on the basis of past performance instead of accurate time studies.

That the system is not wholly successful in avoiding rate changes is indicated by replies of "occasional necessity" for such changes. One company makes a practice of revising rates annually.

Merrick Modification

The Merrick Multiple Piece Rate is simply a slight modification of the Taylor system. Instead of a single step-up in piece rate from below standard efficiency, a second differential is introduced at, say, five-sixths performance, or 83⅓% efficiency. Thus the mediocre workman has a goal more possible of attainment.

CHAPTER IV

MODIFICATIONS OF THE EARLY INCENTIVE SYSTEMS

THE distinctive contribution of Halsey to incentive wage systems was the bonus, subsequently adopted by all who succeeded him. The distinctive contribution of Taylor was the accurate establishment of a standard performance. In later forms of incentive systems, these two features usually appear in combination, although the methods of combination are quite varied.

Gantt Task and Bonus System

Henry L. Gantt, an associate of F. W. Taylor, devised a system which combines characteristics of both the Halsey and the Taylor plans. As in the Halsey system, compensation under Gantt's system is expressed in terms of time wages. However, instead of deducting "for management" a percentage share of the pay for time saved on all work above normal, Gantt adopted the Taylor idea of a distinct standard of achievement, upon attainment of which the worker receives more favorable treatment. Above this standard, the worker receives not merely the equivalent of a full piece rate in the bonus for time saved—instead of a portion only as under the Halsey system—but something additional, as under the Taylor system. Although expressed in terms of the time wage as "120% of time allowed" or "time allowed plus 20% bonus,"[1] the rate is thus equivalent to a high piece rate. In short, the Gantt system is virtually a high piece rate system with a guaranteed minimum time wage, but *centering* at a point of "standard" productive efficiency well above the normal.

[1] Time allowed is, of course, equivalent to Halsey's "time taken plus time saved." The amount of bonus may be varied according to the disagreeableness or other characteristics of the work. Gantt sometimes gave as high as 50% bonus, and the average bonus was from 30% to 40%.

The task and bonus system was designed to give greater encouragement to beginners than the Taylor system offers, assuring them not only a definite wage but also providing guidance to assist them to greater efficiency. Instruction cards comprising the best known methods of performing the various operations were made out and were furnished to the workers. All operations were broken down into their integral parts and the proper time required for completing each minor operation was shown on the card. The sum of all these time allowances was, of course, the standard time for the task, and it was therefore possible for the worker to compare his actual time with the standard time at any stage in the operation, and to know whether or not he was maintaining the standard rate of progress.

Gantt placed great emphasis upon preparing the worker to meet the standard task set up for his particular job. The Gantt charts showing the progress records of individual workers served not only to indicate actual performance but were also devices for improving conditions and methods through publicity and analyses of results. The system of inspection installed was based upon these recorded measures, and was used not only to indicate to what extent workers were up to standard but to suggest how workmen might avoid the errors made. In other words, to avoid the high cost of labor turnover, the first step in the installment of the Gantt system in a factory was to train inefficient workers to meet the requirements of standard production. Recognition of this fact was one of the chief advantages of the Gantt system over the Taylor system.

Determining the Task

The standard task, as originally planned by Mr. Gantt, was intentionally made rather difficult of accomplishment. It was so calculated as to require steady application and the use of the best methods. The worker was assured that by following directions and applying himself he could accomplish his task without undue fatigue. Although sometimes prejudiced against being told how to do his work, the operative was found likely to try out the instructions provided, if only to prove that the task was impossible of accomplish-

ment. The initial earning of bonus was found to be all that was needed in most cases to insure continued effort. Since standards were guaranteed against change unless manufacturing methods were definitely altered, there should have been no fear of a cut in rates to lead to restriction of output. Unfortunately, this was not always true. In spite of the most explicit explanation and years of experience, the fear sometimes persists, and the workers try not to show a record of too big an output.

It was, on the other hand, provided by the plan that if the worker considered the task too difficult, he could, upon proving his case, secure an adjustment in the form of a less severe task.

The task, under fair management, becomes the measure of a day's work. Not only is it recognized by the management but it comes to be accepted as such by the workers. Were the task made too difficult, the workers would lose confidence in the standards and not put forth their best efforts. A fair task outlines what the management expects of the workers and they rarely fail to live up to expectations. A definite goal to aim for has been found to bring about a better coordination of effort than merely the endeavor to accomplish as much as possible. The task idea turns this psychological factor to advantage.

The Gantt system provided also for the payment to the foreman of a bonus proportionate to the number of men under him who completed their tasks.[1] If all his men earned a bonus, the foreman received an additional amount. This served to stimulate the foreman's interest in the work of each of his men, and made it to his interest to devote particular attention to the less successful operatives. There is, however, another side to this question of a foreman's bonus, and that is the suspicion that arises in the minds of the workers that the foreman is driving them for his own advantage.

Tabular Presentation

Again the application of these general principles may be made clearer by reference to the conditions given in the basic Table 9. Such an application is found in Table 13.

[1] In some cases good results have been obtained by making the foreman's bonus depend on the composite quality record. This tends to offset any disposition to sacrifice quality to volume.

TABLE 13: OPERATION OF THE GANTT SYSTEM

(Source: National Industrial Conference Board)

Normal time rate—$10
Standard output—1 piece
Wage—standard and above = time rate × time allowed, plus premium. Under standard = normal time rate
Premium = 20% of time rate × time allowed

Efficiency Grade	*a* Standard Time "Allowed" for Work Done	*b* Computed Value at Normal Time Rate	*c* Premium	*d* Time Wages	*e* Piece Wages	*f* Total Labor Cost per Unit of Time
A	1.50	$15.00	$3.00	$18.00	$12.00	$18.00
B	1.40	14.00	2.80	16.80	12.00	16.80
C	1.30	13.00	2.60	15.60	12.00	31.20
D	1.20	12.00	2.40	14.40	12.00	72.00
E	1.10	11.00	2.20	13.20	12.00	132.00
F	1.00	10.00	2.00	12.00	12.00	240.00
G	0.90	9.00	..	10.00	11.11	250.00
H	0.80	8.00	..	10.00	12.50	200.00
I	0.70	7.00	..	10.00	14.29	100.00
J	0.60	6.00	..	10.00	16.67	40.00
K	0.50	5.00	..	10.00	20.00	20.00

Total labor cost..... $1,120.00
Average labor cost per piece..... $12.25

The underlying idea here, as in some other systems, is that a given unit of work should require for its performance a certain amount of time, and when completed should be paid for at the time rate for the standard time, irrespective of the actual time spent in its accomplishment. In other words, if the job requires a day's time at $10 a day, it should not be paid for at less than $10. A rapid worker, who does the work in half a day should receive the same wage as one who takes a day and a half. This fundamental rate, though modified in practice, accounts for the fact that the "standard time allowed" in the table (col. *a*) is identical with the output per unit of time in the basic Table 9 (col. *b*).

The worker A produces 1.5 units of work in one unit of time; hence the time "allowed" him as a basis of payment (col. *a*) is 1.5 units. Were he paid at the normal time rate, this would be equivalent to a wage of $15.00 (col. *b*). By referring to Table 9, the correspondence of these columns is easily seen. Thus, for example, in Table 9 another worker in group G produces 0.9 units of work in one unit of time and

his basis of payment or "time allowed" is accordingly 0.9 units of time (col. *a*), for which at the normal time rate he would receive $9.00 (col. *b*). But as has been seen in the preliminary discussion, it is at this point that modifications of the general principle are introduced. Beginning with standard performance, class F of the table, a bonus of 20% is received by the workers. Hence the worker in class F, who would otherwise receive $10.00 (col. *b*), receives $12.00 (col. *d*), while the worker A receives $18.00 (col. *d*) instead of $15.00. Below the class F, all workers receive a flat time wage (col. *d*), irrespective of their efficiency.

The labor cost per unit of work or the piece wage (col. *e*) can be computed by dividing the time rate for each class by the output for each class. Since this agrees with the standard time allowed (col. *a*), all the materials for the computation are present in the table. In the standard class F and above, the result of the computation is uniformly $12.00 per unit of work, practically a straight piece system, since the computation of wages, though somewhat involved, is directly in proportion to efficiency. However, below standard efficiency, in classes G to K, a different state of affairs arises through the payment of a flat time rate. The computed piece rate varies with varying degrees of efficiency (col. *e*), increasing as the efficiency diminishes.

For the purpose of computing the total wage cost (col. *f*) for each group and for the total, it is necessary to multiply the piece rate by the total output (col. *f* of Table 9) or to multiply the time wages by the total number of workers in each group (col. *e* of Table 9). The aggregate wage cost to the employer appears as $1,120, the average labor cost per piece as $12.25, and the average wage payment as $11.20.

It will be observed that only those workers who reach standard performance and above participate in this wage increase. The amount of the increase varies from $2 per time unit in class F to $8.00 per time unit in class A, the highest efficiency grade. According to the distribution of workers presented in Table 9, the groups whose earnings are increased include 39 of the total of 100 workers. The remainder receive the time rate of $10, the same as under the time wage system.

Advantages and Disadvantages

The advantages of the Gantt system are: (1) it is expressed in terms of time wages; (2) it avoids the Halsey partial bonus feature; (3) it contains Taylor's "prize" feature, the exceptionally high piece rate for performance above standard; but (4) it avoids the discriminatory wage for work below standard. In theory, the last point makes the system especially successful in cases where the labor supply is of low grade. In practice, there will after a time be very few low grade workers. The least efficient will be replaced, or put at some work within their capacity. Most of the workers below grade will quietly disappear of their own volition, as they do not like the unfavorable comparison with their mates. Again, the avoidance of the discriminatory wage for work below standard is of value when beginners must be "broken in."

Critics of the plan raise objections to the abruptness of the jump from compensation below standard to standard compensation. The man who tries hard to reach the standard and fails by a small margin may, it is contended, become too discouraged to exert himself again. In the second place, records of current performance may prove an insufficient stimulus to increased exertion.[1] The worker, it is claimed, should be given some tangible reward for his effort, even when he fails to reach the standard. Systems embodying modifications to meet these objections will be discussed later.

Experience under the Gantt System

Remembering the limitations in such statistics, it may be noted that plants under the "Task and Bonus" system reported a greater increase in their output resulting from the introduction of the new system than did those which have adopted the Taylor system. The increase in various establishments ranged from 10% to 300%, but the median was 32%. The reported increase in earnings varied from 10%

[1] In the application of incentive systems manufacturers frequently introduce modifications which they deem necessary to meet the conditions in their plants. Thus one concern meets the problem of a sufficient stimulus to the workers who fall slightly below standard by granting one-half of the bonus for a performance which reaches 90% or 95% of the task, with the result that a worker does not feel wronged when failing to reach the task by a fractional amount.

to 30%, the median and average being 20%, or about the same as under the Taylor system. The reduction in unit cost is slightly more than in the plants under the Taylor system, 20% being the median instead of 17%. Rate changes are reported as "occasional" by 36% of the plants, a considerably lower proportion than those using the Taylor system.

It has been the experience of those who use the system that the bonus must be large enough to be a real and adequate incentive; that an inadequate bonus is a great mistake, since men who feel that it is not worth striving for will not exert themselves and thus the whole plan falls down. It is, therefore, of interest to note that in the replies to the questionnaire, a direct correlation existed between the percentage of bonus offered and the number of workers who were able to earn it. In the plants where the bonus offered ranges from 10% to 20%, two-thirds of the workers, on the average, are reported as earning it; where the bonus is from 25% to 50%, 95% of the workers earn it. Whether this correlation is due to the greater incentive of the higher bonus, to the establishment of easier standards by the more generous plants, or to some other reason, is not revealed.

About two-thirds of the plants under the Gantt system replied that they had never had occasion to change the rates; the others changed only on rare occasion. Typical statements on this point are as follows:

> "We never cut an established time allowed for any job, no matter what the bonus earnings are. The only way we allow changes to be made is by changing the method of doing the work."
>
> "Very rarely have we done so. It is better to suffer an apparently too high rate, if it can be done, than cut a rate once set."

Although Mr. Gantt first devised his system to remove the severity of application of the Taylor plan upon the beginner or the less efficient workers, it appears from one or two of the replies to be most admirably suited for transition from straight time to straight piece wages. One manufacturer states that "It is easier than piece work to get across and establish anticipated production increase."

Some of the replies received by the Conference Board stress the advantages of the system in plants where interruptions of work are frequent. Some believe it capable of extended use, while others are more skeptical as to its value, as the following statements indicate:

> "This system was adopted in preference to straight (piece) rates, because the machine processes involved are subject to many breakdowns and interruptions beyond worker's control. On a straight piece rate this would penalize him unfairly so that a guarantee of hourly wage is essential. Nevertheless, the worker, when free from interruptions and breakdowns, has considerable leeway in which he can increase production by his own efforts. The bonus is intended to provide incentive for this additional effort."
>
> "The system is applicable to any plant and to most jobs. We have applied it to jobs varying from inspection to office boys' errands and from square cutting of product to loading and unloading coal with locomotive crane and from inspecting and rewinding carbon paper to cross and rip sawing or tongue and grooving lumber for box shooks."
>
> "Where work can be analyzed and standardized it is applicable. An odd job man can hardly be so placed. Where individual task and bonus is not possible the group may be so handled."
>
> "If flat piece-work will give as good results from production standpoint and not create dissatisfaction owing to wide range of earnings it is best to use it."

The system seems slightly more expensive than the straight piece system, with which most of the answers made comparison, but is deemed to be worth the price. If extreme care and accuracy are devoted to time studies, which Gantt considered an integral feature of his system, it may be made too costly, but in general practice this danger has been avoided, at least by those plants that have adopted the system. The standard time records, and the current records of work done, afford the management a very effective control over production and lost time, a consideration of moment in large factories.

> "System requires more labor in computing pay, but this item is more than offset by increased production."
>
> "You can make it simple or you can make it as difficult as your surplus profits will allow you to."
>
> "It takes the time of three men to make these charts for about 3,000 employees, who are in departments that are actually being charted."
>
> "This system is applicable to any plant regardless of size and types of work. There are no limitations."
>
> "Can be applied wherever a record can be kept of the pieces a man produces."

It is claimed that compensation under the Gantt system can be adapted, if desired, not only to current labor market conditions, but also to intangible qualifications of the individual operator, such as loyalty, versatility, length of service, and the like. Instead of applying the premium rate to the normal market time rate, it may be applied to the individual's time rate. An old employee under the time wage may be receiving $12.50 instead of $10 as his normal wage. Thus, for output above standard, his 20% bonus per piece would bring him $15 per piece.

Attitude of Workers

The introduction of the Gantt system appears to meet with the same adverse attitude on the part of the workers as does the adoption of other systems involving a change from the customary. Fear and suspicion are the chief motives which oppose the change. Much, however, depends upon the method in which the change is effected, whether it is carefully explained and allowed "to sell itself." Some direct testimony on these points may be quoted:

> "There is fear that work will be speeded up and as the workers do not grasp the true principles of time study, they think the task will be set upon their record of performance and try to go slow while being timed. They do not seem to get over this misunderstanding in spite of explanations and experiences. The old foremen oppose the system because they wrongly suppose that it lessens their own importance and shows up past poor performance. They resent having time study men and other so called 'white collar men' come between them and their gang. This is perhaps the hardest obstacle to overcome. Some have to be retired or pensioned. Even department managers are often very embarrassing and obstructive."
>
> "Very little opposition. A few were afraid that the time allowed would be reduced if they made a good bonus. Some of the foremen didn't like it very well because time studies showed that some operations should be done in about half the time usually taken and this made it appear that they had not been getting the production they should."
>
> "No opposition, as bonus in every case was an addition over and above previous hourly wage."
>
> "About one third of men opposed it from the first day they heard of it and some quit because they figured it was a scheme to get more work out of them."

The 100 Per Cent Premium System

The "100 Per Cent Premium" plan resembles the Gantt system, but is without the exceptionally high piece rate for efficiency above the carefully established "standard." Like the Gantt plan, the system is based upon the time wage expression, pay being offered for production above standard at the regular time rate "for the time allowed under standard specifications for the total number of pieces actually completed." Taking the job as a fixed unit, the same idea may be expressed as "a premium at the regular time wage for all time saved over the specified standard time." The plan simply amounts to a straight piece rate converted into time wage expression for efficiencies above standard.

Emphasis is laid upon thorough standardization of processes and the careful timing of operations. A time standard is set for each operation and all time saved over standard is paid for at the full hourly rate of the operator. Standards are guaranteed and can be changed only in case the method of performing the operation is changed. In addition, the operator's hourly wage is guaranteed. Therefore, although this system is almost like piece work in the way it operates, the worker is protected against loss of wages in case he fails to equal the standard.

Tabular Presentation

The operation of the 100 Per Cent Premium plan is illustrated in Table 14.

Like the Gantt system, this plan allows the worker above standard pay for the standard time which his work represents. The standard time allowed (col. *a*) is therefore identical with that in Table 13 and also with the output per unit of time in the basic Table 9 (col. *b*). Wages are paid on the basis of this standard time requirement at the standard rate (col. *b*), but without the additional bonus for classes reaching or surpassing standard, i. e. class F and above. Below class F, all workers receive the customary time rate.

The computed wage cost per piece (col. *c*) for all workers in the standard class F and above is uniform at $10, while below standard it increases as the efficiencies diminish. For

TABLE 14: OPERATION OF THE 100 PER CENT PREMIUM PLAN

(Source: National Industrial Conference Board)

Normal time rate—$10
Normal output—.50 pieces
Standard output—1.0 piece
Wage—Above standard = normal time rate × time allowed. Standard and under = normal time rate

Efficiency Class	*a* Standard "Allowed" for Work Done	*b* Time Wages	*c* Piece Wages	*d* Total Labor Cost per Unit of Time
A	1.50	$15.00	$10.00	$15.00
B	1.40	14.00	10.00	14.00
C	1.30	13.00	10.00	26.00
D	1.20	12.00	10.00	60.00
E	1.10	11.00	10.00	110.00
F	1.00	10.00	10.00	200.00
G	0.90	10.00	11.11	250.00
H	0.80	10.00	12.50	200.00
I	0.70	10.00	14.29	100.00
J	0.60	10.00	16.67	40.00
K	0.50	10.00	20.00	20.00

Total labor cost..... $1,035.00
Average labor cost per piece..... $11.32

lower efficiencies the wage cost per piece is identical with that under the Gantt system; for higher efficiencies the absence of the bonus makes unit costs less.

The total wage cost of $1,035 is lower than under the Gantt system. This means, also, lower labor costs per unit, namely $11.32, and lower average wages, $10.35. Nor do so many workers profit by the change from the time wage system as under the Gantt system. Only those who reach an efficiency in excess of standard enjoy an increase in time earnings. The increase is therefore confined to nineteen workers out of the hundred who make up the group, and the highest increase for the best worker is only $5. All the other workers, eighty-one in number, remain on the level of the former time wage, namely, $10.

Merits of the System

The abrupt jump from the regular time wage to the exceptional piece wage under the Gantt system is avoided by the 100 Per Cent Premium plan. To this extent, however, it

gives the operative a somewhat lesser reward for which to strive than does the high premium under the Gantt system. Nevertheless, by the lower unit wage cost on output above standard, the manufacturer can to that extent reduce the severity of the standard of efficiency and thus bring the goal nearer to possible attainment.

The psychological value of offering the 100 per cent premium is obvious. The worker feels that he is being paid the full value of his time savings. As a matter of fact, however, a worker under this system may conceivably earn less than one of similar skill and energy under the Halsey or Rowan systems. It all depends upon the strictness of the standards. The Halsey and Rowan premium systems pay for only a fraction of the time saved, but the time limits under these systems are not, as a rule, over-difficult. In the 100 per cent system, however, time requirements are very carefully ascertained, and the average worker will not make any excessive savings of time over standard.

The choice between the Gantt and the 100 Per Cent Premium system should be determined with reference to the character of the operatives—their probable response to a lower but nearer reward for standard achievement, or their ambition to attain a greater though more distant reward—and by the different degrees of efficiency and the distribution of these efficiencies among the group of workers.

The calculation of earnings under this system is hardly more difficult than under straight piece work. The very simple formula of pieces to be paid for—that is, completed pieces which have passed inspection—divided by the standard required pieces per hour, multiplied by the operator's hourly rate is all that is needed. Thus, the clerical work required by the system is negligible.

Another advantage is the uniformity of costs. It is true that the cost of work performed by an operator who falls short of standard will vary, but after standard is attained, labor costs will not change no matter how much saving is accomplished. This system appears to be simple and workable in a plant of almost any size, and, provided that standards are fair, should operate satisfactorily to all concerned.

Limited Experience under System

The reports of experience under the 100 Per Cent Premium plan are too few to offer conclusive generalizations. One most striking point manifests itself, however; the unanimity with which companies refer to the advantage of adjusting wage rates to market conditions and to individual qualifications. Although this possibility was occasionally referred to by plants under the Gantt system, it was not emphasized. The worker receives his ordinary day wages; this fact is foremost. After that, if he produces above the standard output, he is to receive extra pay proportionate to his rated efficiency. The two elements, wages and output, are thus kept distinct. A few quotations will bring out varied aspects of the system:

> "Maximum hourly rates are advanced as competition in the district calls for it. Lowering of maximum rate is governed by pretty much the same principle."
>
> "The company had been operating under a straight piece work plan, but due to the continual change in the cost of living resulting in increase hourly wage which necessitated a continual changing in our piece work rates, it was deemed advisable to change to some plan where a standard was set and would not be affected by the hourly base rate."
>
> "We might say that the other qualifications of loyalty, versatility, general adaptability, punctuality, etc., are also considered in raising the employees' hourly rate."
>
> "A beginner in the department would be hired, possibly at 53 cents to 55 cents per hour, whereas an operator who had been with us for four or five years might be getting 65 cents to 68 cents per hour, the difference being the varying qualifications of the men."
>
> "The hundred per cent premium system requires more accurate time-study than would necessarily prevail were the premium established as 50%, 60% or 75% of the saving. However, giving to the workers 100% of the saving is good psychology and effects ultimate costs only as the management ceases to devise ways and means of improving manufacturing methods."

With respect to the attitude of labor, the following statements are of interest:

> "We received no opposition, but rather the hearty cooperation of the workers."
>
> "Individual opposition through lack of appreciation that the set standards could be accomplished. Experience has shown that opposition ceases entirely when it has been demonstrated that the rates allow a sufficient margin whereby extra earnings can be secured."

The "Standard Hour" System

The amount of leeway for regulating a "standard of efficiency" may be very much restricted where time studies are carried to an extreme of accuracy, although not absolutely eliminated, as Gantt and some other writers aver. There must still remain some room for difference of opinion as to how much "rest" time is necessary for the complete cycle of activity. Accordingly, it has been found necessary to devise a plan of adjustment under rigid time study to effect the same result as might otherwise be obtained through regulating the standard of efficiency. One such scheme is embodied in the so-called "Standard Hour" system.

The Standard Hour plan is like the 100% Premium System in that it pays what amounts to a flat piece rate for all production above a certain point of efficiency and a flat time rate below that point. But the point chosen under this plan is not "standard efficiency," but somewhat below, at 70% or 80% of standard efficiency. In the determination of this "bonus point" lies the opportunity to adjust the height or difficulty of performance to be reached in order to receive the bonus. The percentage may vary on different jobs, and thus take into account not only the varying difficulties and hazards of individual jobs, but also adjust the ratio of incentive to particular requirements. In the illustration which follows, the bonus point is fixed at 80% efficiency. At this point, according to Table 9, the converted piece rate is $12.50, and this is paid to all workers who reach or exceed 80% efficiency, giving a time wage at standard efficiency of $12.50. Thus, according to the customary form of statement, workers above the bonus line are paid for the time allowed at the rate of $12.50, and receive a time wage greater or less than standard in direct ratio of their efficiency relative to 100%.

Tabular Presentation

The operation of this plan under the assumptions stated, which shows certain analogies with the 100 Per Cent Premium Plan previously discussed, is shown in Table 15:

TABLE 15: OPERATION OF THE STANDARD HOUR PLAN

(Source: National Industrial Conference Board)

Normal time rate—$10.00.
Standard hour rate—$12.50.
Wage—80% standard efficiency and above = time allowed × standard hour rate.
Below 80% standard efficiency = normal time rate.

Efficiency Class	*a* Standard Time Allowed for Work Done	*b* Standard Hour Rate	*c* Time Wages	*d* Piece Wages	*e* Total Labor Cost per Unit of Time
A 150%	1.50	$12.50	$18.75	$12.50	18.75
B 140	1.40	12.50	17.50	12.50	17.50
C 130	1.30	12.50	16.25	12.50	32.50
D 120	1.20	12.50	15.00	12.50	75.00
E 110	1.10	12.50	13.75	12.50	137.50
F 100	1.00	12.50	12.50	12.50	250.00
G 90	0.90	12.50	11.25	12.50	281.25
H 80	0.80	12.50	10.00	12.50	200.00
I 70	0.70	..	10.00	14.29	100.00
J 60	0.60	..	10.00	16.67	40.00
K 50	0.50	..	10.00	20.00	20.00

Total labor cost $1,172.50
Average cost per piece $12.83

The main difference between this and the preceding table lies at the point when the flat time rate ceases and the bonus rate begins. Under the 100 Per Cent Premium Plan this point was with the efficiency class F, here it is with class H. This means higher time wages (col. *c*) for all receiving bonuses than under the previous system. For these groups it also means a higher piece wage (col. *d*), $12.50 instead of $10. For the lower groups, time wages (col. *c*) and piece wages (col. *d*) are identical in the tables representing the two plans. By reason of higher rates for the more efficient workers, the total wage cost to the employer, $1,172.50; the average labor cost per piece, $12.83; and the average wage, $11.72; are considerably higher in Table 15. The advantage of the increased time earnings reaches 64% of the workers, while 36%, approximately one-third, have stationary earnings. Moreover, the advance amounts to $8.75 for Class A workers.

Relation to Time Wages

The compensation is expressed in terms of time wages, but the rate applies to a standard hour of specified output. The worker's actual compensation is a percentage of the standard wage rate equal to the ratio of his actual output to the standard output—that is, down to the established bonus point, at which point he receives only the guaranteed minimum time wage.

The system is based on a thorough standardization of operations and a careful setting of standards. The number of standard hours is arrived at by multiplying the number of good pieces in a lot by the unit standard for that operation. Thus, if for a given operation, the standard is 15 minutes and an operator turns out 36 good pieces, he is credited with 9 hours at his standard rate. Efficiencies are computed for a pay period and a man's pay will be the sum of the standard hours performed on standardized work multiplied by his standard rate and the hours put in on unstandardized work multiplied by his guaranteed rate.

Applicable to Groups

This plan may be applied to group as well as individual work. The earnings of each worker in the group will consist of the standard hours produced by the group, multiplied by the individual standard rate of the man. The whole operation of the Standard Hour plan may be defined as a guaranteed rate for less than standard performance, and earnings on a straight piece work basis for production in excess of standard.

THE EMERSON EFFICIENCY BONUS SYSTEM

A more widely known plan for extending the bonus to production below standard of efficiency is the Emerson system. Under this system, as usual, a standard of efficiency is determined. At a certain percentage of standard efficiency, say 67%,[1] bonus payments begin, but instead of being at a rate equivalent to a flat piece rate, as under the Standard Hour plan, a carefully graduated scale has been prepared,

[1] This is often the starting point, though 80% efficiency is sometimes used.

giving in effect a time rate rising slowly for the lower grades of performance, and more rapidly for the higher grades. At 100% efficiency the rate becomes almost a straight piece rate, with a very slight decline, set at a high scale as under the Taylor and Gantt schemes. Below 67% efficiency the worker receives his straight time wage.

Fixing the Bonus Rate

As expressed by the Emerson Company, "from 66.6 per cent to 100 per cent efficiency (the worker) receives his hourly rate for the time worked, and an increasing bonus. . . . For efficiencies above 100 per cent he receives his hourly rate for the time worked and a bonus consisting of two parts—first, the full hourly rate for all time saved, and second, 20 per cent of the wage for the time worked."[1] The table for bonus rates below 100% efficiency follows:

Efficiency (Per Cent)	Bonus (Per Cent)	Efficiency (Per Cent)	Bonus (Per Cent)
67	0.01	84	5.55
68	0.04	85	6.23
69	0.10	86	6.93
70	0.20	87	7.63
71	0.35	88	8.40
72	0.55	89	9.20
73	0.75	90	10.00
74	1.01	91	11.00
75	1.31	92	12.00
76	1.61	93	13.00
77	1.99	94	14.00
78	2.39	95	15.00
79	2.80	96	16.00
80	3.30	97	17.00
81	3.80	98	18.00
82	4.34	99	19.00
83	4.95	100	20.00

Above 90% efficiency the bonus increases 1% for each per cent increase in efficiency.

According to the statement quoted above, the total wage for work above standard is to be computed as follows:

$$\left.\begin{array}{l}\text{100 per cent of time wage for time}\\ \text{taken plus 100 per cent of time wage}\\ \text{for time saved plus 20 per cent of}\\ \text{time wage for time taken}\end{array}\right\} = \text{standard time allowed}$$

[1] The Emerson Company, "Comparative Study of Wages and Bonus Plans," 1917 edition, New York City.

Inasmuch as the "time taken" declines with increasing efficiency, the foregoing amounts to a straight piece wage—the converted expression of pay for time allowed—plus a declining bonus per piece, or, in short, to a declining piece rate.

Determination of Standard

As in case of other scientific management systems, the introduction of the Emerson bonus plan is preceded by a thorough analysis and standardization of manufacturing operations and conditions. The shortest and best method of performing each operation is determined by means of time and motion studies, and standards are set after making proper allowances for set-ups, fatigue and special difficulties. The standard represents the performance of a skilful worker which can be repeated indefinitely, and the attainment of this standard is considered 100% efficiency. The worker, however, is not required to equal the standard performance before he is rewarded for extra effort, but is encouraged by small bonuses obtained for fair production to strive for the larger bonuses which reward standard output. Since the basic wage is guaranteed, there is no penalty for failure to attain standard performance.

Tabular Presentation

The main features of the Emerson Efficiency Bonus System are presented in Table 16, which applies the plan to the condition stated in the basic Table 9.

While seemingly more complicated than some of the tables which have preceded it, Table 16 deals in the main with factors with which the reader is already familiar. Time taken (col. *b*) is, as in other tables, identical with the time per unit of product in Table 9 (col. *c*). The time saved (col. *c*) is here computed on the basis of the standard time. For time taken and time saved, regular wages are computed (cols. *e* and *f*) at the regular time rate, and it would not be necessary to separate them were it not for the fact that the bonus (col. *g*) is computed upon the time taken only. The bonus rate (col. *d*) is established according to the rules explained in the text and is not derivable from other figures in

TABLE 16: OPERATION OF THE EMERSON SYSTEM

(Source: National Industrial Conference Board)

Normal market time rate—$10.
Wage—(a) below 67% efficiency = normal time rate.
(b) from 67% to 100% efficiency = time rate for time taken plus premium.
(c) above 100% efficiency = time rate × (time taken plus time saved) plus premium.
Premium = Under standard = graduated percentage of wage for time taken. Standard and over = 20% of wage for time taken.

a Efficiency Grade		*b* Time Taken	*c* Time Saved over Standard	*d* Bonus Rate Per Cent	*e* Wage Per Piece: For Time Taken	*f* Wage Per Piece: For Time Saved	*g* Wage Per Piece: Bonus for Time Taken	*h* Wage Per Piece: Total	*i* Wage per Unit of Time	*j* Total Labor Cost per Unit of Time
A	150%	0.667	0.333	20	$6.67	$3.33	$1.33	$11.33	$17.00	$17.00
B	140	0.714	0.286	20	7.14	2.86	1.43	11.43	16.00	16.00
C	130	0.769	0.231	20	7.69	2.31	1.54	11.54	15.00	30.00
D	120	0.833	0.167	20	8.33	1.67	1.67	11.67	14.00	70.00
E	110	0.909	0.091	20	9.09	.91	1.82	11.82	13.00	130.00
F	100	1.000	..	20	10.00	..	2.00	12.00	12.00	240.00
G	90	1.111	..	10	11.11	..	1.11	12.22	11.00	275.00
H	80	1.250	..	3.3	12.50	..	.41	12.91	10.33	206.60
I	70	1.429	..	0.2	14.28	..	.03	14.31	10.02	100.20
J	60	1.667	..	..	16.67	..	..	16.67	10.00	40.00
K	50	2.000	..	..	20.00	..	..	20.00	10.00	20.00

Total labor cost..... $1,144.83
Average labor cost per piece..... $12.53

the table. The total piece wage (col. *h*) appears then as the sum of the three preceding items. The wage per time unit (col. *i*) is obtained by multiplying the piece rate of each efficiency class by the units of work produced by the worker in the class.

Further to clarify the matter, the results for the worker A may be considered. Since he produces 1.5 units of work in one unit of time, he takes 0.67 of a time unit (col. *b*) and saves 0.33 of a time unit (col. *c*) for each work unit. He is paid for both at the standard rate of $10 per time unit, and therefore receives $10 composed of $6.67 for time taken (col. *e*) and $3.33 for time saved (col. *f*). In addition, he receives a bonus payment of $1.33 (col. *g*), which is calculated at the rate of 20% (col. *d*) of the payment for time taken (col. *e*). Thus his total wages per piece amount to $11.33 (col. *h*), and if this be multiplied by the number of

pieces produced in one time unit, 1.5, it is seen that his time wage (col. *i*) is $17 per unit of time.

One more illustration will be helpful. A worker in class G produces 0.9 units of work in one unit of time. He therefore takes 1.1 units of time (col. *b*) and saves no time of standard. He is paid for the time taken at the regular rate, receiving $11.11 (col. *e*). In addition, he receives a bonus, which for this grade of worker is 10% (col. *d*). His bonus therefore amounts to $1.11 (col. *g*) and his total piece wage to $12.22 (col. *h*). Multiplying this piece rate by his product, 0.9, it is found that his time wage is $11 (col. *i*).

A study of the details of this table shows that for workers of standard performance or better, a fixed rate of bonus (col. *d*) prevails, and that it is applied to the wage payment for time taken. Hence the longer the time taken, the greater the amount of bonus (col. *g*); and the shorter the time, the less the bonus. This bonus being added to the standard time wage of $10 per unit of time, it follows that while the piece wage of the worker who produces at the standard is $12, this rate becomes less as higher grades of efficiency are attained. In the piece wages of these standard and super-standard workers there is a difference between $11.33 paid the most efficient man of all and $12 paid to the man who just reaches standard. However, differences in earnings measured by different degrees of efficiency appear in the time wages of these groups (col. *i*). The best worker receives $17 as compared with $12 paid to the standard worker.

For workers in classes below standard, who receive a minor bonus, the piece wage (col. *h*) is highest for the least skilled (class I), while the time wage (col. *i*) is highest for the most skilled (class G). In the two classes at the bottom of the list, the flat time rate determines the piece rate.

The total labor cost to the employer (col. *k*), computed by methods which have become familiar, appears under this system to be $1,144.83; the average labor cost per piece, $12.53; and the average wage, $11.44.

Operatives of grade G and above experience a substantial increase of time earnings, which varies from 10% for grade G to 70% for grade A. These workers number 64 in a total of

100. In grade H, 20 workers have an increase of 3.3% in their time earnings, while 10 workers in class I receive only two cents more for each time unit and their earnings can be regarded as practically stationary. The remaining 6 workers get exactly the same amount as under the time wage system.

Merits of the System

There are many workers in a plant who can rarely reach the standard performance, but who, for the sake of the reward they can obtain for an output short of standard, will continue to strive for the maximum earnings within their reach. There are many others who can and do steadily maintain an output equal to or above standard, to whom the bonus earned will be a constant stimulus not to slacken their efforts. Because of his high output, the more bonus a man earns the more profitable he is to his employer, but the Emerson incentive plan does not, like the Taylor and Gantt plans, discourage the man who is unable to equal the standard.

Whatever may be said for and against the psychology of giving the less efficient workman the smaller incentive as compared with that of the employee above standard, the Emerson system avoids Gantt's abruptness of the change from the time wage to the high piece wage, and great flexibility is possible under this system in the making up of schedules for jobs of differing intensity. It is not considered advisable to change the bonus rate for different kinds of work, since jealousy and ill feeling is likely to result. But a reward above the average may be placed within the reach of the worker performing unusually exhausting or disagreeable work by making the schedule easier, and hence the attainment of standard less difficult.

Although advocates of the Emerson system claim that "an employer can well afford to pay a large bonus," deriving "his own benefit from the increased output of the plant and the greatly reduced overhead," such an assertion, as explained with reference to Taylor's claim to the same effect, must be considered in connection with the particular circumstances of the industry. Possibilities of adapting the system to the industry, the type of labor, the product, and the like,

lie: (1) in the stringency of the standard adopted as 100% efficiency; (2) the height of the starting point for bonus payments; (3) the scale of early graduations of bonus; and (4) the height of the additional bonus (here given as 20%).

Experience under the Emerson System

According to the replies received from plants that are using the Emerson system, production seems to have been increased anywhere from 25% to 100%, and earnings from 10% to 100%, while unit costs were reduced 15% to 50%. In spite of the fact that 80% to 90% of the employees were reported as earning premiums, companies do not appear to have experienced much necessity for cutting rates. Changes in rate occur rarely, except when they become necessary through changes in machinery or process, although there are occasions when rates have to be revised on account of errors in the original rate setting. This is indicated by the testimony which follows:

> "Where obvious errors have been made, standard times are either increased or decreased in co-operation with the worker. Otherwise no change in standard times for any operation is made except where method or conditions are changed."
>
> "We do not do so except by mutual agreement with the men effected, unless methods or processes have been changed. Usually complaint from men regarding "tight" rate gives chance to adjust "tight" and "loose" rates at one time."
>
> "Because our Standards are skilfully and carefully set in the beginning, in no case have we found it necessary to change them unless conditions changed."
>
> "It has not been necessary to change standards or time limits, except in cases where the speed of the machines has been varied and this was clearly understood by our operators when the system was established."
>
> "It is fundamental *not* to do so for such a reason."

Field of Application

The testimony of employers indicates that the system is widely applicable:

> "The Emerson system is applicable to plants of any size and for nearly every type of work with the exception of a few. The Emerson methods are the best and easiest, in my opinion, to operate."
>
> "I see no reason why this system, modified to particular conditions, would not be applicable to plants of any size and to any type of work.

It is simply a compromise between the old piece-work system, by which a man's whole pay was affected by production, and the straight time in which the production had no effect on his pay. The ideal condition is to so arrange the bonus system that enough of each man's wages is dependent on his bonus, so that an incentive is provided to make him want to put in his best efforts."

"The ideal conditions for this system are a man or group of men who have been accustomed to a flat hourly rate; who control to a large extent the efficiency of their process; whose output is measured in concrete figures; whose work is the same day after day or at least recurrent to a proper extent to allow the same standards to apply from one time to the next. In general, we would say that there are few plants which could not make use of bonus payments in certain phases of their work. And there are just as few who can adopt a bonus system whole and apply it to every detail of their processes."

"I think it would be hard to apply it exactly to other than recurrent operations. I have applied it successfully to certain office jobs like the making of invoices. It could be used with these limitations in plants of moderate size—100 men or even less. The principle of reward for attainment of a carefully predetermined standard is widely applicable."

"Applicable to any and all plants. It would precipitate a strike if we were to propose discontinuance of system at this time."

"Size is not believed to be a factor. It is applicable to any class of work on which standards can be set and some method established to control quality."

Attitude of Workers

Opposition on the part of the workers to the introduction of the system, when it occurred, seems to have been merely "the usual natural resistance to new methods," or "fear that the management was attempting to drive them to do more work for less money." If care is taken when the system is introduced to explain it thoroughly to the workers, these initial objections can usually be overcome. Thus, manufacturers report:

"This requires patient explanation by the foremen when new men come into our employ."

"Spirit of fairness shown to all complaints of individuals soon clears up all start of trouble in spite of recurring 'stock' objections."

After the system is in operation, it appears to be sufficiently well understood by the operatives. Like most incentive schemes, the workers prefer it to the time wage when they have become used to it. On this point there is considerable pertinent testimony, some of which follows:

"We have had practically no labor trouble due to dissatisfaction with the system. The only cases where we have had any difficulty are those where a new operator is downright obstinate or prejudiced against any form of piece work system due to his experience in some other plant where the time study privilege was abused or unless he is unwilling to produce a fair day's work. These cases we will admit are very, very rare."

"The average worker wants to work on the premium basis and objects to working on a day work basis, which they still have to do about 5% of the time."

"Our people are desirous of having their jobs 'timed out' as soon as possible in order that they may earn premium."

"Not any (objection to time studies) unless it is to object because the time study is not taken quick enough so that premium can be placed on the job."

"After the system was installed in one department, other departments threatened to quit in a body if the system was not extended to them."

Although the system has been criticized on the score of complexity, almost three-fourths of the replies stated that, in operation, it is "simple and inexpensive," and that "the workers understand clearly the method of calculating earnings." One plant went so far as to assert that the system is "simple and cost is less than other methods tried," and, with regard to the calculation of earnings, another stated that the workers "always know on each day practically to the cent what their earnings will be." But other employers give a less enthusiastic endorsement:

"It is not simple except in principle. It is expensive to operate but pays well."

"The system is not particularly simple or inexpensive; neither is the time and expense required prohibitive for shops on so-called production work 'many pieces of the same.'"

"It is not simple. Each operation has its standard and actual time to be computed and the efficiency per cent and the reward determined. It is presumably worth the effort."

In answer to the question of whether the workers understand the method of calculating earnings, the general opinion, expressed in statements such as the following, is that they only rarely comprehend it fully:

"They did not."

"No. However, we teach all those capable of understanding how to figure their own bonus earnings."

"In general the workers do not clearly understand the method of calculating earnings."

"It has been our experience that the operators become acquainted with the system very quickly and are able to figure their earnings with surprising accuracy. They often detect the slightest error in calculating their premium earnings."

"A large number seem to grasp the method very well, some have difficulty."

"They understand a great deal more than they are given credit for. You can't fool them in matters of earnings."

"This has been a source of some misunderstanding and required personal explanation."

"The Emerson system is too complicated for the average worker. Very few are able to figure their pay."

Other Modifications of the Early Incentive Plans

There are innumerable incentive wage systems other than those analyzed in the foregoing pages, many of which are dignified by no distinctive titles, but for the most part these are modifications of the general principles illustrated in the better known examples selected.[1] One modification of the Gantt system, somewhat similar to the Merrick three-step differential piece rate, has been successfully applied. Under this plan, at some point below standard efficiency, say at 90%, a higher level of time rate is granted to workers. This device works very well because it gives workers who just fail to reach the standard some extra reward, and avoids penalizing the inevitable occasional shortages due to faulty material and unusual interruptions. The Knoeppel Bonus system is similar to the Emerson system, with the exception that it restores the sudden step-up which is the feature of the Gantt and Taylor systems. Space prohibits a detailed study of these minor systems, and the experience of the manufacturers under one or another is so limited, so far as revealed in the replies to the Conference Board questionnaire, that conclusions would be unreliable as a criterion of merits or practical use.

[1] The Parkhurst Differential Bonus System offers a distinctive feature and, although presented in the next chapter on account of its other aspects, should be read in connection with the systems under immediate discussion.

General Features of Incentive Systems

All incentive plans, like the original piece system, aim to increase production, decrease unit labor costs, and afford the worker an opportunity for increasing his earnings. Bonus or premium systems differ from the piece system in being expressed in terms of time wages. This keeps remuneration closely conformable to the market time wage. It facilitates the transition from the unduly high wage per unit of product under the normal time wage to the lower rate per piece under incentive production. From the viewpoint of psychology, bonus systems, by retaining the time wage expression, may be less open to objection on the part of the worker, but this advantage tends to be offset by their greater complexity.

Unfamiliar Methods Stir Up Resistance

The element of complexity probably counts more against a system in its adoption than in its operation. To be sure, every employee wants to be able to figure his own earnings, but this can be accomplished even under complex systems by using fairly simple formulæ or rate scales. The underlying obscurities of the system will not trouble the mind of the operative after it is in operation, so long as he gets results in his pay envelop, any more than the science of logarithms need trouble an insurance clerk with his annuity table at hand. The replies to the question as to whether "the workers understand clearly the method of calculating earnings," therefore, must be taken in the practical sense as indicating whether the systems are workable after the men have accepted them.

Methods Only Partly Understood By Workers

Of ninety-three plants using premium systems of one kind or another, sixty-six stated they believed that their employees understand clearly the method of calculating earnings. In twenty-two cases it was felt that in general the method was understood, though not by all workers; and five plants replied definitely in the negative. The following statements bear upon this point:

"Many never will understand it, but the better men do."

"No, but they have wonderful confidence in the management."

"There is no difficulty on the part of the operator in computing his earnings, in fact, even our dullest type of operator is able to detect a shortage of a few cents if an error has been made on the part of the payroll department."

"We hold classes to teach everyone the arithmetic of calculating their earnings. Many of our girls did not know arithmetic but can now figure their own pay if they care to. About 50% do so."

"A few can calculate earnings to the penny and if complaints and questions are properly handled every one will soon have full confidence in fairness of calculations."

"The more intelligent type of operators understand very clearly the method of calculating their earnings but at least 50% of the men simply understand in a general way that more product means more bonus."

"As a rule they do not, although rates and schedules are posted in departments."

"They know that if they increase production they will get more money and they feel on the whole that we are trying to give them a square deal."

Explanation of System Important

Doubtless very much depends, in introducing a new system, upon the personality of the engineers in charge of the installation, the extent to which the workers are taken into the confidence of the management, the general intelligence of the employees, and like considerations. Of the 101 plants answering the question, eighty replied that the new system had been thoroughly explained, ten had given a partial but evidently not very complete explanation, two had explained it only to the foremen and nine had given no explanation at all. To quote from the questionnaire replies:

Halsey Premium System

"Before introducing the system all the men of the department were called together and the premium system was explained to them, giving them at that time the opportunity of making inquiry on any points that were not clear to them."

"It was thoroughly explained to each man as he was placed under the system."

Bedaux System[1]

"This point is considered very important."

"A special effort was made along this line. The system must be sold to the supervision and workmen at the time of its installation."

[1] Details of this system will be found on page 103 of this volume.

Gantt Task and Bonus System

"We just advised the men that on certain jobs they could get a bonus and let them sell the idea to themselves, which they did in about two months."

"In our judgment this is absolutely essential for success."

Emerson Efficiency Bonus System

"Not by open meetings and 'talks' but individually to those men who because of skill or personality were leaders to a greater or lesser extent."

"The operation and reason for the various features was explained by the Management to a committee elected by the workers. Furthermore this committee functioned during the installation of the system as a clearing house for any differences of opinion as to the correctness of rates, methods, etc. It also served to explain the system to workers who did not fully understand it. Every care was taken to solicit the cooperation of the workers."

"The system was carefully explained to all operators in a joint meeting so that any discussion would be heard by all."

Miscellaneous Bonus Systems

"Not to any large degree."

"These explanations are very necessary, yet much must be taken on 'faith' so that the confidence which the operators have in the company is usually responsible for trouble or the lack of it."

"No one of these systems should be introduced 'en masse.' It should be one man at a time when he is ready. Explanations should be personal. It is a big mistake to talk too much about what you are going to do. Do it and let experience justify it. Taylor said, 'Don't try things. Do them.'"

Probably the variations in experience with regard to the workers' attitude at the time of the adoption of a bonus system may be accounted for to a great extent by the different policies pursued in the method of adoption, rather than by the character of the system itself. The testimony as to the attitude of workers from those who use incentive systems is illuminating:

"Worst kind of opposition—nearly causing strike," but—"It would precipitate a strike if we were to propose discontinuance of systems at this time."

"Strenuous at first, but we simply stated a proposition which workers could go after when they chose. After one or two had 'broken loose' the rest was easy."

"The usual natural resistance to new methods. Nothing serious."

"We introduced it carefully by putting only two picked men on bonus work. As they immediately succeeded in making bonuses the

other men insisted on being put on the bonus plan faster than we could set the rates. We were careful not to appear to be forcing the plan upon them. There were a few isolated cases of men who for a while were too stubborn to take advantage of the plan."

"No opposition at all. Have had more trouble in not being able to put work on bonus fast enough than any other one thing."

"The plan was put into operation first with foremen only. When they began to receive a bonus the operatives were in favor of having it applied to them also."

Improvement of Industrial Relations

It is characteristic of all incentive plans alike, to judge from the questionnaire replies, that after installation of the new system the relations between management and workers are improved. This fact was corroborated by seventy-two of the eighty premium or bonus plants which expressed their opinions on this question, although opinions ranged from doubtful acknowledgment to enthusiasm, and eight plants did not attribute any improvement in industrial relations to the wage system. One of the latter plants found friction developed because of the disparity in the earnings of bonus and hourly workers. The following are a few of the statements which testify to improved conditions:

"We are so well satisfied with this system that we could hardly think of our being back on the straight rate plan. The men are given to understand that they can make as much out of the job as there is in it. To use the language of the street, we might say 'the sky is the limit.'"

"It has been our experience that the system has tended to reduce friction on wage questions and promote harmony in industrial relations. There is no comeback when a man complains that someone else is earning more than he; we simply show them that it is purely a matter of industry and efficiency."

"While we have no concrete examples to offer there is no doubt that it has settled the wage question for us in the departments where it is used."

"Our men like it and most semi-skilled men are anxious to change from day work to premium."

"No more arguments with workers on rates. The money and time elements have been separated. This has caused workers to discuss time units on the basis of time required to do the work rather than on the basis of 'get all you can.'"

"A little friction appears at times especially when one man finds out that his neighbor made a little more premium than he did."

"We think a premium system is bound to bring out arguments that do not exist otherwise. A combination of liberal guaranteed pay plus premium, all in proper relative proportion does promote harmony and reduce friction. It is not the premium system but good management plus liberal proportionate and consistent pay that produces the ideal. This is our object and aim but still we do have arguments."

"The worker who is making a good thing on premium is well satisfied, but the fellow who is not getting much or anything on premium, is envious of the fellow who is."

"The premium system was adopted in one department and after being in operation there for a few weeks the men in the other departments requested that the premium system be extended to their departments also. This we believe is proof that the system will promote harmony in industrial relations."

"The system has gone a long way toward reducing friction on wage questions and promoting harmony in industrial relations."

"We have not had a request for an increase in wages from anybody now working under the Bedaux system."

"Our workers seem better satisfied in the departments on the Bedaux system than in those yet on the piece work basis."

"It offers a better opportunity for a square deal to both the workmen and the Company. Each operator knows positively that he is getting the same base rate for the same class of work as his brother workman and that he has an equal opportunity to earn in accordance to his ability."

"It is not a system that produces or reduces friction. It is the policy, tact, consideration and method of handling it."

"Employees seek advice and make every effort to improve themselves. This advice is given freely, thereby creating harmony and good fellowship."

"We think there is less friction than under the old piece work systems; at least, there is very much less running of the employees to the superintendent for rate changes and allowances."

"Many workers have brought their friends because 'there are no bosses crabbing them to get busy.' The element of driving men to work is entirely removed from industrial relations."

"The men feel that once the base rate is up with the market, the rest depends on themselves, and they thus become in a sense operatives on their own account, with the profits, according to the bonus table, all theirs."

"The bonus system has very materially reduced friction on wage questions."

"Being equitable, the system is instrumental in creating and preserving a pleasant relation."

"Everyone wants to keep busy as much as possible because it means more bonus. This desire to keep on the job is responsible, probably, for a fair degree of our increase in output."

"It has reduced friction. Generally speaking, when a man wants to make more money, instead of arguing for a higher rate he either works a little harder to make more bonus or exercises his ingenuity to make the task easier."

CHAPTER V

PLANS TO "EQUALIZE" COMPENSATION THROUGHOUT THE PLANT

THE chief advantage of bonus or premium systems, as has been explained, lies in the fact that they are expressed in terms of time wages, which permits ready adjustment of wage rates to market conditions. It is further claimed that these systems permit adjustment of compensation to the personal qualifications of individual employees, although evidence to this effect is somewhat inconclusive. Real difficulty arises, however, in regard to adjustment between different types of work within the same plant.

Among the replies to the questionnaire sent by the National Industrial Conference Board to plants using "incentive" systems, there is repeated reference to discontent on the part of the workers arising from some alleged discrimination between different types of work. Operatives on one job may be able to earn a bonus more easily than those on another, since in one instance the job may be 80% or 90% machine work and limited in operation to a specified rate of speed, while the other job is more largely a matter of individual skill. Another job may require great exertion, so that while susceptible of increase, the strain or fatigue becomes injurious.

Under the ordinary time wage system such differences can be taken account of without arousing discontent, since there is too little basis for direct comparison by the employees themselves; but where mathematical formulæ are used to measure compensation in relation to volume of output, even when expressed in terms of time wages, attention is often drawn to the obvious differences in bonus rates for various lines of production or to almost equally obvious differences in the ease of earning bonuses in various lines.

With a view to establishing a sound and definite measure

whereby basic wage rates might be made closely commensurate with differences in types of work throughout the plant, industrial engineers have been led to devise the so-called "equalization" systems.

The Bedaux Point System

The plan put into effect by C. E. Bedaux consists in reducing all work to terms of a common denominator, thus making it possible to establish differences in compensation that could be easily recognized as legitimate and which, by being formulated correctly in the first place, would remove the risk of any further discontent following upon a change in standards.

Briefly, Mr. Bedaux proceeded to analyze and reduce all industrial effort into elementary motions, and to determine the rest periods necessary to compensate for each type of strain, such as fatigue from the muscular effort required to handle weights or apply pressure, the strain from rapidity of movements, that due to the sequence of particular movements, or merely to the position of body or limbs.

Basic Principles

As a result of these careful studies, three general laws were formulated:

1. "For a muscular effort of a given power, the ratio of strain is directly proportional to the rapidity of motion and completion of the cycle."
2. "Rapidity of motion is inversely proportional to weight handled, pressure applied and length of cycle."
3. "For a muscular effort of a given power, the duration of work and rest periods is inversely proportional to the rapidity of motion."

Tables of allowances were made up to take care of strains induced by the sequence of motions, and also by the position of the body and arms. The limits of the curve for relaxation time in proportion to working time were 15% and 210%. This wide range was due to the greatly differing requirements of the various types of effort.

Since all manufacturing operations are combinations of certain elementary motions, and since the exactions of each of these elementary motions had been carefully determined, it followed that the work and relaxation proportion for each operation could be ascertained. It only remained to devise a unit of measurement to translate each operation into terms of requirements for every other operation.

Practical Application

This unit of measurement, termed by Mr. Bedaux the "B," is defined as one minute *composed of relative proportions of work and rest as indicated by the requirements of the whole job*. Thus Job X may take ten minutes of straight labor to perform, but if the work is to be continued throughout the day, rest may be required amounting to five minutes, a ratio of work to rest of 2 to 1. The "B" for X would be a minute of 40 seconds' labor and 20 seconds' rest. Job Y, on the other hand, may take two hours to complete, and being easy work require only 20 minutes' rest. The "B" for Y is a minute composed of 6/7 work and 1/7 rest. Thus, in terms of "B's," a 60B hour on X would be directly comparable to a 60B hour on Y.

From this point one may go further. The standard of efficiency for completion of X being 15 B's and for Y being 140 B's, a worker completing X in 10 minutes would be of the same grade of efficiency as a worker who finished Y in 93⅓ B's, and since the differences in their jobs have already been taken care of in the composition of their respective "B's," they are clearly entitled to the same bonus, which is usually calculated at the rate of 75% of the wage equivalent of the time saved.

The bonus system used by Mr. Bedaux is, from the operative's viewpoint, the Halsey system, with a premium rate of 75% of wages for time saved over standard. From the viewpoint of the management, it may be a 100% premium plan, starting at a base of normal productive efficiency, with the remaining 25% to be pooled for distribution to supervision and indirect labor for their services, which are counted in as assisting the operative to reach his over-standard performance.

Experience under the Bedaux Point System

The system, as applied in one of the plants, is briefly described as follows:

> "The system consists of taking a time study of an operation and finding the standard time required, adding to this approximately one-tenth to cover tool difficulties, etc., and the number of minutes reached in this method determines the number of points assigned to each operation. One minute equals one point. We operate ten hours per day or a total of 600 points. We make an allowance of twenty points per day for necessary delays in production. The earning of an employee is figured by multiplying the number of pieces produced by the points allowed per piece, then deducting from this total 580 points required for a day's work at the guaranteed hourly rate and then the operator is paid ¾ of the amount left in points at a rate per hour, always bearing in mind that one point equals one minute. For example—An operator on a job which allows 20 points turns out in ten hours 40 pieces giving him a total of 800 points, subtracting 580 points leaves 220 points to be paid for at his hourly rate which, we will say is $0.45 per hour, ¾ of which would make his point value .0056 which would give for the 220 points $1.23 premium, which added to the $4.50 guaranteed day rate would give him a total earning for the day of $5.73."

In practically all the plants, the basic wage is determined by the prevailing market rate for the type of work, in question, with due consideration for other elements, such as cost of living, which normally affect time wages. Only occasional mention is made of any specific consideration paid to individual qualifications. The base rate appears to be uniform for all engaged on one type of work.

With such care and accuracy devoted to time studies, there would seem little necessity to change standards or time limits on account of high earnings. The following statements from manufacturers confirm this fact:

> "It has been our policy to re-time and adjust standards only when changes of process occur. Standards are set on time and not on money values, consequently they are guaranteed indefinitely, provided there has been no change in process. We encourage our operators to give us their maximum production. At no time do we change standards on account of high earnings. Should it be absolutely necessary at any time to reduce the cost on any particular job on which it is felt that the earnings were out of line with other classes of work, the logical way to readjust the earnings would be to change the base rate."
>
> "The standards are units of time and not money. The money

element represented by the hourly rate would be changed on a decided change in labor rates in the community but the standard or measure of production would remain the same."

"We have not found it necessary to change standards on account of high earnings. Whatever changes we have made have been to simplify the operation and this is done with new time studies. It is essential that most careful time studies be made at the outset."

One company protects itself by "habitually setting rates low." If experience with an operation shows that the rates are too low, they are raised. Since all rates are guaranteed, they are never reduced.

The bonus percentage adopted has regularly been 75%, as provided in the original plan, but only about half the replies mention the distribution of the remaining 25% saving among employees engaged in indirect work. In the other plants, the 25% balance probably finds its way into the "profit and loss" account. Of the operatives under the system, 85% to 100% —average 95%—are reported as earning bonuses.

Motives for Introduction

Although the distinctive contribution of the Bedaux system is the equalization of remuneration for different tasks throughout the plant, this feature is not often specifically recognized. In reply to the question of why the Bedaux system was adopted, most plants gave the answers customary for the adoption of any incentive system, namely, increased production, increased earnings for labor, and decreased unit costs. Some of the more discriminating replies, however, were the following:

"The Bedaux Point System was introduced into our plant primarily to increase production and to decrease cost; also to reduce labor turnover and *to place our wage payment system on a more standardized basis.*"

"We had at the time of application no consistent system of wage payment."

"The system, in our opnion, is about the most flexible and scientific yet devised for the remuneration and for the controlling of factory costs and production, for accurately measuring results in a common unit known as the point. The 'point' as a unit of measure may be compared to the 'watt' in electricity."

"The Bedaux System was introduced to establish a better control over the relationship between productive and non-productive labor, and make it possible to pay bonus to supervision for earnings in their respective departments. The Bedaux system furnishes a measurement of effort and as this measurement is not based on monetary value, it provides for changes in rates to meet conditions in the Labor Market."

"System was introduced because of the desire to obtain a premium system that would be constant and to pay workmen according to their worth, length of service, skill, etc."

"Our base rates for similarity of work are uniform in all departments. This originally was left mostly to the judgment of the different foremen or supervisors. Their opinion as to what rate should be paid and as to how much their men should earn varied considerably. These difficulties and unfairness to labor are practically eliminated under our system.—Each operator knows positively that he is getting the same base rate for the same class of work as his brother workman and that he has an equal opportunity to earn in accordance with his ability."

"In our opinion the Bedaux System provides a very attractive incentive for maximum production and provides an exceptionally satisfactory means of executive control by means of which the performance of each individual and each department is measured by a common unit."

Field of Application

The system appears to be applicable to work of a repetitive character, where the product can be easily measured and is of sufficient quantity to justify the installation of an inventive plan. Some plants go so far, indeed, as to affirm that it is suitable for all types of work. Typical comments are as follows:

"We believe this system can be applied to any job and any plant. We have successfully used it for such work as trucking, copper plating, carbonizing and hardening and gun barrel drilling where the work is done by teams of men sharpening their own tools and keeping the machines in repair."

"No limitations so far as we can see except that plants must be large enough to justify the cost of installation."

"Eventually 98 per cent of production will be covered by standard, 2 per cent being such work as is so special as not to warrant expense of time study. We expect that when the system is completely installed all factory work, productive and non-productive, with the possible exception of tool-making, will be operating under the system."

A more conservative and perhaps more carefully considered statement is the following:

"The system is applicable to plants of any size where there are jobs of repetition in steady quantities. We do not believe it has been particularly beneficial to stimulate effort in non-productive office work, where the direct relations to the shop in their relation are not constantly before employees."

Cost of the System

The cost of installing the system is undoubtedly an important consideration for the small establishment. The general opinion of the plants that have adopted the plan is that it is not what one would call "simple and inexpensive." Some of the rather qualified comments are "reasonably so," "as any," "after it is installed," "more complicated, but worth it." Other remarks are:

"The system is simple and inexpensive to operate but requires considerable interest and attention on the part of the management."

"Much more payroll work."

"Plants must be large enough to justify the cost of installation."

"The system is more difficult and more expensive than piece work or day work, but covers a much larger field and increased production and lowered costs more than justify the expense."

"After having been properly installed, the system should not be any more expensive to operate than the average piece work wage payment system."

"Factory end is O. K. Much more office payroll work necessary. Time allowance for payroll clerk is 38 minutes per man per week for Bedaux system but only 6 to 8 minutes per man per week for other day or piece workers in factory."

"The initial cost of the installation of the Bedaux system is such that we think it would not be an economy to install it in a factory having a productive payroll of less than $2,500.00 per week."

Nevertheless, the testimony received by the National Industrial Conference Board reveals a few exceptions to the general experience:

"It is our opinion that this type of system could be applied to most any size of factory—in fact we had it operating very satisfactorily in one of our plants with approximately 100 employees."

"Three per cent of the payroll easily covers the cost of operation of the system."

Once installed, the system appears to obtain adequate results. The increase in production reported ranged from 15% to 100%, the average being about 50%—higher than that

under any of the other systems. Increase in earnings ranged from nothing (in one instance) to 50%, with an average of 20%. Decrease in unit costs ranged from 5% to 50%, with an average of 20%. Labor turnover reduction averaged from 15% to 20%. More supervision is required, it is reported, but in contrast with most replies from plants using incentive systems, a third of the plants asserted that the quality of the product had actually been improved. Whether this was accompanied by a special quality proviso in the premium agreement, or by the addition of more inspectors, does not appear from the questionnaire.

Attitude of Workers

After it is in operation, the system appears to be sufficiently well understood by the operatives. One plant, indeed, replies with some warmth, "Yes. If they are one cent off, they will know it and kick." In general, familiarity with the system usually overcomes initial objections. Opposition arises at the beginning, from suspicion of exploitation and fear of being driven harder, dislike of time studies and of the "office" knowing too much, and similar causes.

The testimony of users of this system corresponds very closely with that given by those who employ other types of incentive systems. What applies to one applies with little variation to all. All systems encounter occasionally the stubborn man who can not and will not see that new methods of paying wages may be to his advantage. Here, as elsewhere, men who have at first been skeptical of the innovation later become eager for it; when the system is introduced gradually there is often a demand for its more rapid extension from one department or one class of work to another. The increased earnings of those who gain the bonus become the most convincing arguments in favor of the new system, according to the general tenor of the replies which were received to the questions of the National Industrial Conference Board.

The Haynes-Manit System

Another development in wage payment plans is the Haynes-Manit system. This plan was first used in industry in 1921, and information regarding it was first made public

in 1924 in a paper presented to the American Society of Mechanical Engineers. Since then, the Haynes Corporation has considerably modified its original plan. It has, however, retained the characteristic of being a point system, that is to say, all work is reduced to "standard man-minutes" of work.

The Manit Defined

In the Haynes-Manit system, a Manit represents four-fifths of the amount of work that a normal worker can turn out in a minute of time without over-exertion and irrespective of the nature of the task. The standard number of Manits set for each task is determined by time-study analysis. The number of Manits which a worker produces is a measure of his efficiency. This rating is comparable to that of all other workers in a plant, regardless of differences in the nature of the work. Group standards and group ratings are developed for any kind of work that is essentially of a group character, but the number of individuals in a group is always as few as may be practical for the application of the system.

Stress is laid in the discussion of this system on the universality of the Manit. It is to be noted that, as a unit applicable to the work of an entire plant, the Manit is in effect a unit of effort rather than a unit of definite work. The diversity of tasks within the plant makes it necessary to establish a specific Manit standard for each type of operation. A comparison of Manit standards does not refer to the work done, which may require very different grades of skill and may result in units that are quite diverse, but refers to the effort required to do the tasks set. On the assumption that the Manit standards for different operations have been equitably set, the system furnishes a measure by which one may compare not only the Manit performance of different workers on the same job, but those of workers on different jobs, and of different departments of the plant with one another.

How Earnings Are Computed

An illustration will facilitate an understanding of how the plan operates. Let us assume that a riveter drives 6,000 rivets in a day, or 10 rivets per minute. Translated into the terminology of this system, a worker who drives 10 rivets per minute is credited with one Manit. Let us say that each worker is paid at the rate of 75c per 100 Manits. If, then, a worker drives 6,000 rivets during the day, he receives 6 × 75c, or $4.50. If worker A drives 7,500 rivets during the day and is credited with 750 Manits, he receives 7.5 × 75c, or $5.62½.

Advantages of the Plan

Because of the common denominator—the Manit—which is used as the basis of comprehensive labor control records, and because the Manit makes possible the development of an equitable incentive plan for supervision and indirect labor, as well as for direct workers, much more effective departmental team work is developed, which results in increased production per-man-per-hour, lower costs, and increased earnings of supervision and indirect as well as direct labor. Special incentives for maintaining and improving quality of workmanship are also established in accordance with the requirements of each department. The Manit ratings (efficiency) of the various departments in the factory can also be compared as necessary budgeted allowances are made for time consumed by work that may not lend itself to the setting up of Manit standards because of the inapplicability of time studies. The efficiency of supervision is rated and bonuses are paid for supervision according to these efficiency ratings. "The total amount of bonus paid for supervision and indirect labor is limited to 4½% of the combined earnings of direct workers who produce individually at a daily rate in excess of 60 Manits per hour; but such bonus is not deducted from, nor taken out of the earnings of the direct workers."

It must be remembered that the extent to which the Manit system introduces a satisfactory measure of comparing output of workers in different occupations depends upon the degree to which the various jobs are capable of having criteria set up for standard making purposes. However, the Haynes Corporation claims to have been successful in applying the Manit system to such highly diversified work as hand composition in a job print shop, and to the manufacture of orna-

mental chandeliers produced in quantities ranging from one to five of each particular design. The Manit system can be operated independently of the rates of pay for the various tasks in a plant, as the Manit standards are established on a time basis instead of on a money basis. This permits of complete flexibility in applying the Manit system to all classes of labor, regardless of the difficulties of the job and the experience and training necessary. Of considerable importance is the fact that the degree of improvement possible on the part of different workers and departments varies with their pre-Manit ratings (labor efficiency).

Essential Features of the Manit System

In the last analysis, and Manit system embodies the very desirable simplicity of piece work. However, Manit standards underlying conditions of operation remain constant and do not fluctuate with changes in the labor market. Adjustment to such changes is made not by variation in standards but by variation in rates of pay.

While under the Manit system, compensation rises or falls with greater or less accomplishment, as it does in piece wages, the method of computation is not only different but offers the opportunity for greater flexibility. When, for example, a man is engaged to work at 60c an hour, it is understood that the hour upon which compensation is to be based is the accomplishment of 60 Manits of labor, not the passage of 60 minutes of time. At the end of eight hours by the clock, the worker may have done only seven hours of work, or he may have done nine hours of work. In the first instance his pay would be $4.20, in the second $5.40, calculated at 60c per (Manit) hour. It might be added that for a limited period of time, or perhaps indefinitely, the worker so engaged might be guaranteed a minimum rate per hour of time. The obvious purpose of such a guarantee for a limited time is to allow the worker to adjust himself to the system and to its standards. Where no time limit is placed in the guarantee, it is more than probable that in practice a worker who failed to do better than the guarantee would be unable to retain a permanent position in the shop. Whether or not a minimum hourly rate is guaranteed for employees is determined in

accordance with the policy of the company installing the system, since it can be operated equally well with or without a minimum guarantee.

The Haynes-Manit system, moreover, differs from the piece wage system in the fixation of standards. Where piece wages prevail, attention is apt to be given exclusively to the number of pieces finished, while the Haynes-Manit system like most specialized incentive systems, takes more definitely into account all of the operations, both primary and incidental, which are intrusted to the operator. Moreover, the piece wage system is usually inflexible; it has for all operators the same rate on a given type of work. This fixity is not necessarily a feature of the Haynes-Manit system. Differential rates per hour, based sometimes upon length of service, sometimes upon proved ability in operation revealed by Manit records, may be used for workers engaged in the same operation. It might be said that the Manit is considered primarily as a unit of measurement. As such, the number of Manits to the credit of the worker determines his actual pay within his rate class, but the features which fix the rate of pay for each class of work may be, and usually are, perhaps, independent of Manit records.

It will be observed that in the establishment of a definite unit applicable to all kinds of work within the plant, the Haynes-Manit system has the same purpose in view as the Bedaux system. The units of the two systems differ, as do the methods of determining them. Since these methods have not been fully disclosed, a more definite comparison of the two systems will not be undertaken here.

The Parkhurst Differential Bonus System

The Parkhurst system might equally well have received a place in the previous chapter as in the present; it is not only a plan for the "equalization of tasks throughout the factory, but its chief contribution, as we shall find, lies in its final or most complete separation of the bonus from the customary time wage. It is placed in this chapter since attention has been chiefly directed to its "equalization" feature.

In piece wage systems, the dollars and cents reward for

exceptional output is a direct price per unit of product. In the premium systems, the reward is reached by applying the percentage of efficiency to the time rate. Under the Parkhurst plan, the bonus is a definite scale of dollars and cents established for different efficiencies on different classes of work. The time wage for the employee is entirely distinct, even to the point of being delivered in a different pay envelope.

The bonus scale, indeed, is the starting point of the system. Fifteen different rates are established, applicable to different kinds of work, with steps, at "standard efficiency" for each class, of 25 cents, as Class 1, 25c; Class 2, 50c; Class 3, 75c; Class 4, $1.00; Class 5, $1.25; and so on. Above standard efficiency for each class, and below, down to 50% efficiency, the bonus is a constant ratio of cents to percentage efficiency increments. In this manner a complete scale of bonus payments for different classes of work is established. The following partial scale will illustrate:

Job Efficiency	Bonus Paid for Full Day's Work in Various Bonus Classes				
	4	5	6	7	8
70%	$0.45	$0.57	$0.69	$0.80	$0.92
75	.55	.68	.82	.96	1.10
80	.64	.80	.96	1.12	1.28
85	.73	.91	1.09	1.27	1.46
90	.82	1.02	1.23	1.43	1.64
95	.91	1.13	1.36	1.59	1.82
100	1.00	1.25	1.50	1.75	2.00
etc.					

It is the task of the efficiency manager or industrial engineer of the company to fit each job to be brought under the system into its appropriate bonus pigeon hole, as it were. This is done with due consideration to all the variable elements, such as the degree of skill required, responsibility of the worker using costly machinery, etc. Moreover, several grades of work may be recognized in each job as designated. Light drilling, for example, may be classified in Class 3, a lower grade of drilling in Class 2 and a higher grade in Class 4. The proportion of machine work and time for rest and relaxation are also taken into account, along with other factors.

The "market rate" of wages for a given kind of work is, of course, a general guide for the classification of the job, but it does not serve as a direct basis for computation of the bonus, as it does in most bonus systems. An employee's bonus pay is entirely separate and independent of his hourly wage, and is not a percentage of it. The job and bonus classes once established are guaranteed permanently. In short, time wages are individual, varying from the market level according to the man's particular qualifications, such as length of service, loyalty or versatility, as under the straight time wage system. The bonus pay, on the other hand, is absolute, based upon the job, regardless of who may be working on it.

The objection to this system is obvious. Whereas the regular wage, being the straight time wage, retains all the advantages of flexibility of the time system, the bonus is inflexible, guaranteed and permanent, regardless of whether the general level of wages goes up or down, whether the cost of living rises or falls, or whether business is flourishing or depressed. This difficulty, however, is more apparent than real *if the initial classification of jobs is set wisely*. No objection on grounds of unfairness is likely to arise (as under the Halsey and Rowan systems), for the question of piece wages or 100% remuneration for time saved does not enter in. The bonus is a "bonus" in the strict sense of the word. The only comparison that the employee is led to make is between the bonus he receives and what another worker receives. Since this is a matter most carefully guarded by the detailed time studies, fatigue allowances, etc., records can always be placed before the complainant for explanation and inspection. Indeed, there seems no reason why, for the "equalization" of jobs is the plant, the Bedaux Point system may not be used in combination with the Parkhurst Bonus classification.

A second factor of safety is available in the limitation of the percentage of efficiency above which any bonus is to be paid. While the complete pigeon-hole system of bonus payments may be left unchanged, it is quite feasible—in fact it is the general practice—to pay no bonus below about 70% efficiency. In times of stringency, the limit may be raised with little danger of serious disturbance among the workers, chiefly because it affects only a small number, those between the older and the newer margin.

CHAPTER VI

INCENTIVE SYSTEMS APPLIED TO GROUP PRODUCTION

THE foregoing discussion of systems of wage payment has proceeded on the assumption that the product upon which efficiency is to be measured is that of individual workmen. Frequently, however, the finished article is the joint product of a number of workmen. It may be impossible to separate the functions of the various workers of the group into measurable activities suitable for the application of efficiency tests.

It is often possible under such circumstances to treat the joint product as a unit and the group of workers as an individual, simply distributing whatever bonus may be earned by the group on the basis of the relative wage of each member. The same principle may be applied to "overhead" and clerical work. It has also been adopted successfully for an entire plant as a unit, thus virtually merging into a sliding scale system of wage payment based upon product instead of profit or price.

Any practical incentive plan may be applied to groups instead of to individuals, but, to quote the words of one manufacturer:

> "It is important in the group bonus plan that the work done by the members of the group either be the same or very closely related so that the men can cooperate with each other in obtaining a maximum of production in a minimum of time. If there is nothing about the work which permits cooperation then there is no argument for a group bonus plan except that it reduces the expense of keeping payroll records."

Advantages of Group Bonus

There is one advantage in the group bonus that does not appear in the individual bonus, namely, the development of an *esprit de corps* and the strong pressure of group sentiment

bearing upon each member to maintain his share of the operation at his best ability. Thus one manufacturer reports:

> "We have placed several jobs on bonus which required the activities of a group of men on different operations and have pooled the earnings in proportion to the amount of time that each man worked on the complete job. We have been especially pleased with the result on this type of work, as we find a great willingness on the part of more experienced men to help the newer men, and they even go to the extent of advising the foreman of any man who does not show a willingness to do his share of the gang's work. We have further used the pooling proposition on a crew of three or four men if performing the same operation on one lot of material going through, and by penalizing the entire group for poor workmanship on the part of any one member of the group, we have been able to secure some reduction of poor workmanship in these particular operations."

Moreover, under the group system there is a better opportunity to recognize intangible qualities, as will appear from the following:

> "The individual is also taken into consideration in establishing the base rate, for with the old employees and those we know give us the best that is in them we recognize in the base rate. Inasmuch as the base rate is established for each individual and not for the group as a whole, it can be changed at any time without in any way affecting the operation of the system. It is possible to give recognition to any feature entering into the payment of employees."

Disadvantages of Group Bonus

In spite of these particular advantages, however, the group bonus usually seems to be applied in practice where it is not possible to apply the individual system. The preference for the individual application may be due to the greater incentive to production, avoidance of disputes between members, and the better opportunity afforded the management to keep a direct measure of individual efficiency. In a group, poor workmanship of one member may be covered up in superior activity of the others. Not only may one individual be so "carried" by others, but where the group system is extended to cover the plant, some departments have to carry others. This may prove particularly objectionable in the practice of directly retaining part of the bonus of the so-called "productive" departments to distribute to the "overhead" em-

ployees. Finally, a possible objection remarked by one manufacturer, is that the group bonus "has a strong tendency to make the men organize, at least informally, in cliques and become somewhat dictatorial."

Combination of Group and Individual Bonus

These disadvantages of the group system can be avoided, and the advantages of both the group and the individual incentive schemes retained by a combination of the two. This is possible, however, only when individual accomplishment is capable of measurement. The group, which may be quite arbitrarily established, earns its bonus on the basis of its total product, but the apportionment of the bonus among the members is based upon individual achievement instead of simply upon basic wage differences.

Systems in Operation

Systems in operation in some of the plants may be described in the words of their executives:

(A) "We have classified our bonus system as the 'Emerson Efficiency Bonus' but . . . we measure the efficiency by the production of an entire department and not by that of any individual employee. Our bonus is paid in addition to the regular hourly rate of wage, the amount of the bonus being one-half of one per cent of efficiency in excess of 70 per cent of a predetermined standard."

(B) "In general principle the bonus is based on production in excess of what our records showed as normal over a period of years, and is reached by charging the number of man hours against the quantity produced. Each bonus period is of four weeks. Where the tabulation shows that the plant production has been greater for the four week period than normal, every factory employee is given that percentage of bonus on his earnings for the same four weeks. In other words, where an employee has earned $25.00 each week for four weeks or a total of $100.00, and the bonus earned is 10 per cent, the employee for that period is paid $110.00 or $10.00 bonus. All factory employees share alike on the percentage basis, as we feel that even non-productive employees have a direct bearing on plant production.

"It functions in such a way that when we are very busy the employees by their efforts, can earn a bonus, and when orders become slack the possibility is automatically removed. We have found it very satisfactory from every standpoint."

(C) "This arrangement is as follows:—We estimate a labor cost on a job at a certain day rate. We then pay the men this day rate and allow them as bonus whatever saving they can make in production. In explanation:—should we estimate a labor cost of $1.00 on a piece, and they could produce a sufficient quantity to reduce the cost to 75 cents each, 25 cents bonus would be distributed among the men equally."

(D) "Approximately 25% of our operators work on a premium system similar to the above, (namely, 25 cents per hour for any saving over the estimated time) excepting that the total premium for the month is pooled and the net amount of saving distributed among them."

(E) Group Bonus with Guaranteed Hourly Rate: "Requirements are set for this group of workers corresponding to production under, say, 85% efficiency. A bonus is paid on each 1,000 pounds produced over these requirements, the total bonus being distributed among the workers in proportion to the hours each works in addition to the flat hourly rate. If the workers fail to earn bonus they receive the flat hourly rate only. This bonus averages around 15% of the weekly wage at the hourly rate.

"Beginning Wednesday, November 8, 1922, it is proposed to establish a bonus system of wage payment, based on production efficiency of the factory as a whole. The bonus will be paid as a percentage of each man's wages for the bonus period (four weeks) when the general shop efficiency exceeds the percentage fixed as standard.

"The general shop efficiency is based on two factors: 1—The production per payroll hour in the producing departments. 2—The percentage of indirect payroll hours in the non-producing departments to total payroll hours.

The Standard Time:—"A standard time has been established for each of our regular parts and for assembling and repairing complete valves and regulators. The standards are based on records made during the past two and one-half years. 100% efficiency under these standards represents the best time possible under our conditions.

How Shop Production Efficiency is Figured:—"The production efficiency of the shop is based on these standard times. All the production of a bonus period is multiplied by these standard times and reduced to *production hours*. The total production hours for the period are divided by the payroll hours of the producing departments for the period and the result is the production efficiency.

How the Efficiency of the Non-Producing Departments is Figured: —"To keep down non-productive or overhead expense and to create an incentive for men in those departments to cooperate in reducing unnecessary expense, they will also be included in the bonus plan. The payroll hours of the non-producing departments will be computed as a percentage of the total payroll hours of the factory. The standard set is 30%. When the non-producers' hours exceed 30% the excess of hours will be added to the payroll hours of the producing depart-

ments and the general shop efficiency decreased. When the non-producing hours are less than 30% the difference will be deducted from the payroll hours of the producing departments and the general shop efficiency will be increased.

How the Bonus is Figured:—"The bonus will begin to operate when the general shop efficiency reaches 60%. For every per cent increase in efficiency above 60% each shop employee will receive one per cent increase in his wages for that period."

(F) "Under our system every employee gets the same per cent bonus. Certain departments are dissatisfied because they have to 'carry' other departments. This is the principal defect with the system, and is not yet satisfactorily corrected.

"The nature of our work is such that an individual bonus would work hardship on our best men, who have to work on special work which cannot be standardized."

CHAPTER VII

SUMMARY

THE problem of wages has two broad aspects: (1) the share of the national income to be apportioned to labor as a factor in production; and (2) the best method of payment of wages to obtain the highest efficiency of production under the modern industrial organization.

The first of these problems lies beyond the scope of the present inquiry, which is concerned with wages not as a problem of general economics but with methods of paying wages as an aspect of industrial management. The manufacturer must accept the usual and customary wages of labor as a given element in his managerial problem. His special concern is not to determine the rate of wages, but to decide upon a method of payment of this "prevailing wage rate," or something approximate thereto, which will stimulate the employee to his highest productive effort.

Inasmuch as with modern conditions of money exchange, the time wage is the only system under which comparisons between compensations in different fields of activity can be made, the manufacturer's first question must be whether it is not possible for him to obtain desired results without modifying or abandoning the time wage system. He may seek to accomplish this by closer and more personal supervision, facilitating quicker recognition of valuable qualities with appropriate reward, since no system of wage payment can offer a substitute for the human element. Or the time wage may be retained and the objective of maximum production at least cost be reached by an entirely different approach, namely, by mechanizing the entire process of production so that each worker must regulate his operation to keep pace with another. An old fashioned egg timer (like an hour-glass) has been used to synchronize the work of a construction gang of some three thousand laborers.

The plant may be too large, however, to permit effective personal supervision, and the production processes too independent of one another to permit "pace-making." There remains the alternative of adopting an "incentive system" of wage payment. The general considerations which the manufacturer must bear in mind in his choice of an incentive system, already discussed in the foregoing chapters, may be briefly summarized here.

Measurement of compensation by *quantity of output* implies production of comparable units. The adoption of any incentive system is thus dependent, to begin with, upon an adequate volume of output of a uniform and measurable product. If under present methods these conditions do not obtain, can the manufacturer so subdivide or reorganize processes as to bring about proper conditions for the adoption of an incentive system? Or again, may not the joint product of the group be taken as the unit, and a group incentive system adopted?

If volume and uniformity of product permit, further considerations must be taken into account. Adoption of a new system will be influenced by the grade of intelligence or of the leadership of the employees. The distrust of the employee toward anything new or unusual varies inversely with his intelligence. This consideration, however, is modified by confidence already established by the management among its employees. When the management has won this confidence, men will accept with less question the guidance of those they trust. Even an unintelligent working force may be induced to accept a complex wage system, or one widely different from that which has been in use, simply through the leadership of a trusted fellow worker or foreman, or the employer himself.

The direct cost of introducing and maintaining a new wage system is a matter for most careful consideration. The more complex systems require accurate time studies, careful records and considerable bookkeeping, which for a small concern might prove prohibitive. The volume of output, the variety of orders, changes in machinery or methods which would necessitate constant revisions of standards or time studies to set new standards, will determine whether an incentive system is possible, or what particular system is most suitable, and the degree of accuracy advisable in setting standards.

Again, the character and composition of the force, from the viewpoint of the workers' prospective capabilities for increasing their production, will be a consideration influencing not only the choice of the system but the amount of the bonus the rate of the piece wage, the scale of the bonus for different degrees of efficiency, the severity of the "standard output" limits, and similar decisions.

By process of elimination of the methods and devices not suitable to his particular case, taking into account the size of his establishment, character of his product, type of his labor, composition of his force with regard to capability, etc., the manufacturer can reach decision as to whether an incentive system is necessary or feasible, what sort of incentive system is most appropriate, and what specific scale of rates will give the greatest advantage to himself and his employees.

As industrial competition throughout the nations of the world grows more and more intense, with manufacturing no longer confined to the countries of Western Europe, but developing rapidly in Japan, India, Australia, Canada and South America, and as the superior advantages of quantity production compel larger and larger enterprises, the American manufacturer will find "incentive systems" of wage payment increasingly urgent. A sound understanding of their essential principles is therefore very important.

APPENDIX

APPENDIX

COMPOSITION OF THE WORKING FORCE IN RELATION TO WAGE SYSTEMS

In order to explain the different systems of wage payments resort was had in the text, to a definite situation of facts regarding the degrees of efficiency exhibited by the workers, and the number of workers to be found in each degree of efficiency. To this assumed situation major systems of wage payments were successively applied, in order that the method of operation of each system might be explained upon the same basis as was used in the exposition of other systems.

It was insisted that the purpose of these comparisons was to show merely methods of operation, and it was stated, among other things, that different positive results would of course follow if the distribution of the workers was different from that stated. It is to the examination of this point that this appendix is directed.

The most convenient method of procedure will be to compare the results already stated in the text as applicable to the distribution assumed in Table 9 with the main results which would follow from other possible distributions of the workers.[1]

The characteristic of the hypothetical distribution contained in Table 9 was a concentration of the workers at a point lying between "minimum" and the F group. The groups representing efficiencies of from 70% to 90% contain 60 out of the 100 workers to which the table refers. This distribution will in this appendix be designated as A.

Another possible distribution of workers may be assumed in which the bulk of the number are found centered about group F. In this distribution, designated as B, 56 out of the 100 workers are found in the three efficiency groups, 90% to 110%, the remainder being equally divided among the higher and the lower efficiency groups, with the numbers diminishing as the efficiency grows greater in the upper groups, and as it grows smaller in the lower groups. This distribution corresponds in the main to what statisticians call a normal distribution.

A third distribution, C, is constructed upon still a different basis, and takes account of the tendency of incentive systems generally to

[1] See Table 17, p. 128 of this volume.

eliminate producers of less than standard efficiency. It is here assumed that 80 of the 100 workers reach standard efficiency and over. With such a distribution the greatest number will be found at standard efficiency, with the number in each group diminishing as the efficiency increases. Most of the 20 workers below standard are found in the group having 90% efficiency, and the remainder in dwindling proportions in the groups of lower efficiency. If it be objected that the presence of even this small number of low grade workers is inconsistent with the principle of selection stated, it should be remembered that at any given time a group of workers will necessarily contain a certain number of beginners, who can not be expected to reach standard performance until their experience has increased.

Finally, and purely for the sake of illustration, a fourth or D distribution may be selected, which is the exact reverse of A. The characteristic of this grouping, admittedly wholly improbable, is a concentration of workers in the higher degrees of efficiency. Here 60 of the 100 workers are assumed to be in the efficiency classes between 110% and 130%.

The details of these distributions and the output to be expected under each are shown in Table 17.

TABLE 17: DISTRIBUTION TYPES AND OUTPUT UNDER THESE TYPES

(Source: National Industrial Conference Board)

Efficiency Grade	Output per Unit of Time	Distribution Types				Output by Types			
		A	B	C	D	A	B	C	D
A	1.50	1	1	3	5	1.50	1.50	4.50	7.50
B	1.40	2	3	6	10	2.80	4.20	8.40	14.00
C	1.30	3	6	9	25	3.90	7.80	11.70	32.50
D	1.20	4	12	12	20	4.80	14.40	14.40	24.00
E	1.10	5	18	20	15	5.50	19.80	22.00	16.50
F	1.00	10	20	30	10	10.00	20.00	30.00	10.00
G	0.90	15	18	10	5	13.50	16.20	9.00	4.50
H	0.80	20	12	4	4	16.00	9.60	3.20	3.20
I	0.70	25	6	3	3	17.50	4.20	2.10	2.10
J	0.60	10	3	2	2	6.00	1.80	1.20	1.20
K	0.50	5	1	1	1	2.50	0.50	0.50	0.50
		Total Output in units				84	100	107	116

The distributions have been named and presented in the order given for the purpose of emphasizing the fact that the greater the concentration of workers in the higher grades of efficiency, the greater

will be the product reasonably to be expected. So far as incentive systems operate to bring into play a selective process unfavorable to low grade workers, they heighten the result to be expected from securing from each member of the group an output proportional to his efficiency.

Next to the consideration of the volume of the output, the total cost and the cost per unit are perhaps of first importance. The text discussion showed how these costs varied under the different incentive systems. It is the purpose of Table 18 to show how they may differ under the same system with different conditions as respects the distribution of employees among the several efficiency grades.

TABLE 18: EFFICIENCY DISTRIBUTIONS AND TOTAL AND UNIT LABOR COSTS UNDER THE VARIOUS INCENTIVE SYSTEMS

(Source: National Industrial Conference Board)

System	Total Labor Costs				Labor Cost per Unit			
	A	B	C	D	A	B	C	D
Halsey.....	$1,340.00	$1,500.00	$1,570.00	$1,660.00	$15.95	$15.00	$14.67	$14.31
Rowan.....	1,368.35	1,478.19	1,514.42	1,549.02	16.29	14.78	14.15	13.35
Taylor.....	1,149.00	1,435.40	1,573.00	1,717.00	13.68	14.35	14.70	14.80
Gantt.....	1,092.00	1,212.40	1,292.00	1,404.00	13.00	12.12	12.07	12.10
100% Premium	1,035.00	1,077.00	1,110.00	1,195.00	12.32	10.77	10.37	10.30
Standard Hour	1,125.00	1,268.75	1,350.00	1,462.50	13.39	12.69	12.62	12.61
Emerson.....	1,107.10	1,219.08	1,281.38	1,371.38	13.18	12.19	11.98	11.82

Total labor costs increase, of course, as numbers in the more productive grades increase. However, the unit labor costs are successively lower from A to D in the case of the Halsey, Rowan and Emerson systems, because these systems result in successively lower piece rates as the scale of efficiency increases. In the 100% Premium plan and the Standard Hour plan, the piece wage is uniform above a given point of efficiency, and increases below these points. The effect of changing the distribution of workers in Table 17 is to reduce these elements which have comparatively high piece wages. Hence, as the efficiency of the groups as a whole increases, the labor cost per unit diminishes but not so much as in the case of the systems first considered. In the case of the Gantt system the labor costs per unit are uniform for standard efficiency and above, are less in efficiency grade G and higher in the lower grades. Hence, with emphasis on the upper groups in the B, C, and D distributions, the unit cost is considerably less than in under the A distribution. It appears slightly higher in D than in C,

by reason of the greater emphasis in the former case on the efficiency class G, which is represented by 10 workers in the D distribution and by 5 in the E distribution. The Taylor system shows throughout an increasing labor cost per unit of product as the distribution shifts to the higher groups of efficiency. A reference to the explanation of this system in the text shows its principle to be a high piece rate for the higher grades of efficiency.

The effect of the different distributions of the workers upon their time earnings under the different incentive systems is exhibited, so far as average earnings are concerned, in Table 19.

TABLE 19: EFFICIENCY DISTRIBUTIONS AND AVERAGE EARNINGS UNDER THE VARIOUS INCENTIVE SYSTEMS

(Source: National Industrial Conference Board)

System	Average Earnings			
	A	B	C	D
Halsey	13.40	15.00	15.70	16.60
Rowan	13.68	14.78	15.14	15.49
Taylor	11.49	14.35	15.73	17.17
Gantt	10.92	12.12	12.92	14.04
100% Premium	10.35	10.77	11.10	11.95
Standard Hour	11.25	12.69	13.50	14.63
Emerson	11.07	12.19	12.81	13.71

TABLE 20: EFFICIENCY DISTRIBUTIONS AND THE NUMBER OF WORKERS WHOSE EARNINGS ARE AFFECTED UNDER THE VARIOUS INCENTIVE SYSTEMS

System	A		B		C		D	
	Earnings		Earnings		Earnings		Earnings	
	Increased	Unchanged	Increased	Unchanged	Increased	Unchanged	Increased	Unchanged
Halsey	95	5	99	1	99	1	99	1
Rowan	95	5	99	1	99	1	99	1
Gantt	25	75	60	40	80	20	85	15
100% Premium	15	85	40	60	50	50	75	25
Standard Hour	40	60	78	22	90	10	90	10
Emerson	60	25[1]	90	6[1]	94	3[1]	94	3[1]
		Decreased		Decreased		Decreased		Decreased
Taylor	60	40	90	10	94	6	94	6

[1] The time earnings for the group classified as stationary were, in fact, $10.12. In addition to those covered in the table, there were under distribution A, 15 persons, under B, 4 persons; and under C and D, 3 persons each, whose earnings were less than the normal time wage of $10.

Since the tendency of all incentive systems is to increase the earnings of the workers of higher efficiency grades, average earnings increase with the degree of concentration of the workers in the higher grades of efficiency.

The real significance of such systems lies not in the way they affect the leaders or the average worker but in the way they affect the rank and file workers. This is displayed in Table 20, which shows to what extent the body of workers participate in the increased earnings.

Generally speaking, the increase of average earnings inures to the benefit of a considerable proportion of the workers. Those who do not share in the increase remain for the most part on their former wage. Two of the systems start from normal market time rate as a basis, and some of the others guarantee it to the below standard workers. In two systems only, the Emerson and the Taylor, do the methods permit a decrease in earnings for below standard workers.

The effect of concentrating the workers in higher grades of efficiency is obviously to reduce the proportion of those whose earnings remain stationary or suffer a diminution. Where the distribution is a normal one, the proportion of those who lose by the change from a time wage system is insignificant.

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